VOLUME XLIV NUMBER TWO

THE NATIONAL GEOGRAPHIC MAGAZINE

AUGUST, 1923

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ARTICLES and photographs are desired. For material which the Magazine can use, generous remuneration is made. Contributions should be accompanied by an addressed return envelope and postage.

IMMEDIATELY after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resultant given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization which was waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the historic expedition of Admiral Peary, who discovered the North Pole.

NOT long ago The Society granted $25,000, and in addition $75,000 was given by individual members through The Society to the Federal Government when the congressional appropriation for the purchase was insufficient, and the finest of the giant sequoia trees of California were thereby saved for the American people and incorporated into a National Park.

THE Society is conducting extensive explorations and excavations in northwestern New Mexico, which was one of the most densely populated areas in North America before Columbus came, a region where prehistoric peoples lived in vast communal dwellings whose ruins are ranked second to none of ancient times in point of architecture, and whose customs, ceremonies and name have been engulfed in an oblivion more complete than any other people who left traces comparable to theirs.

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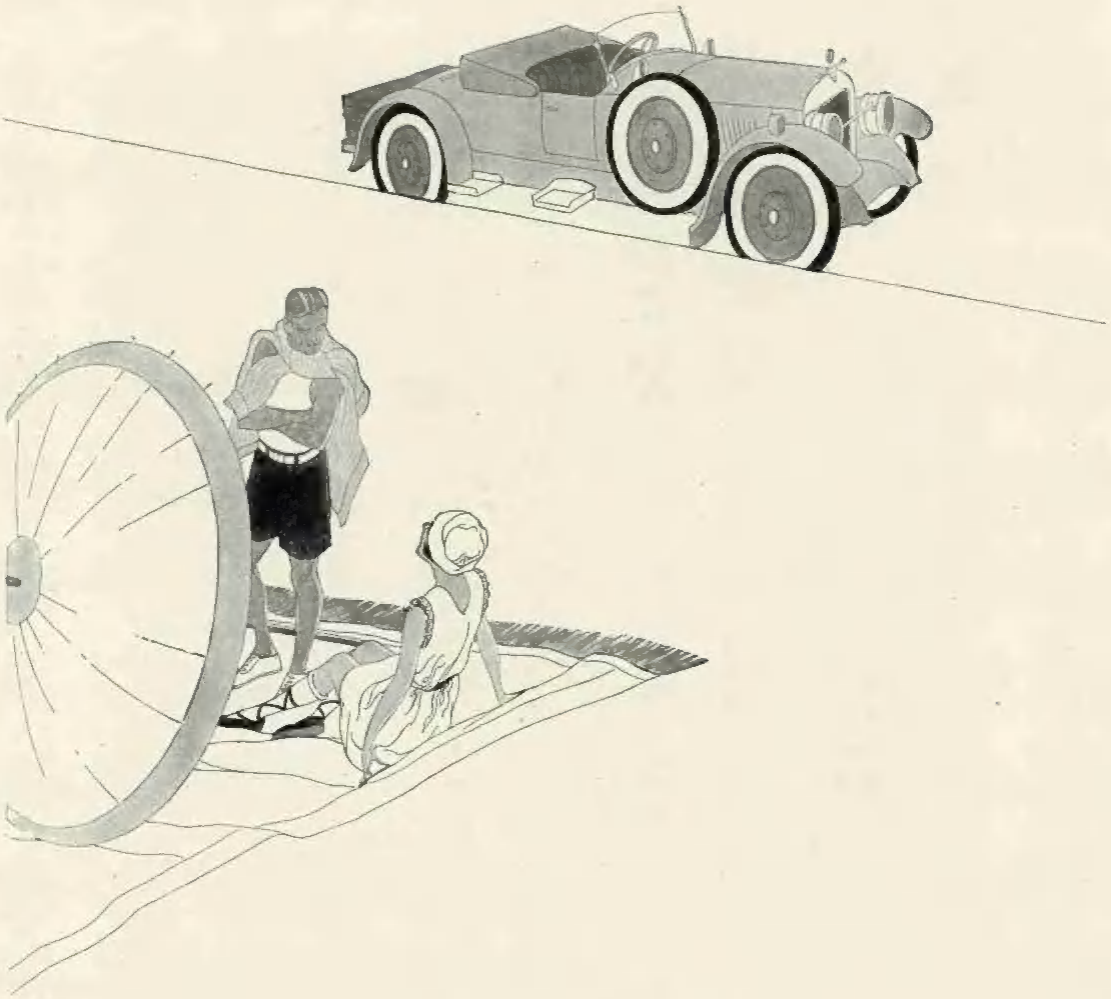

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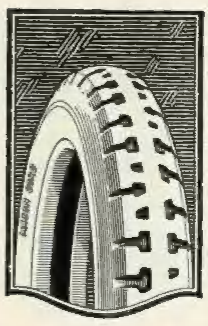

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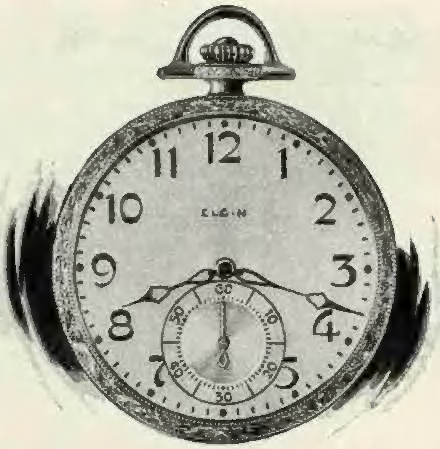

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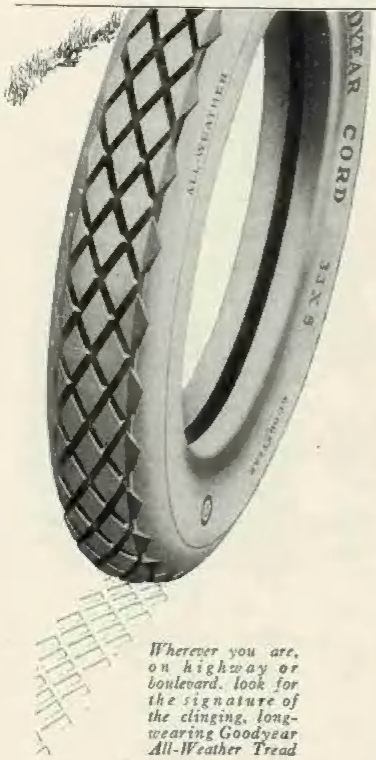

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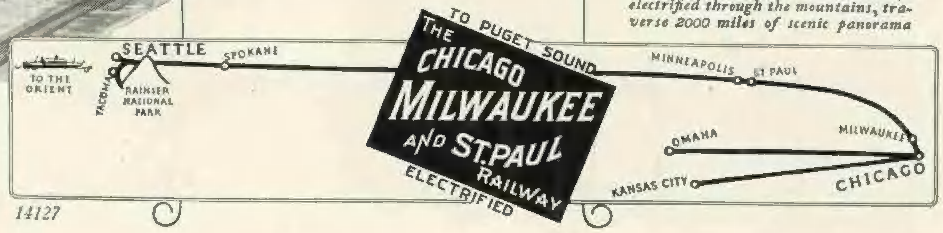

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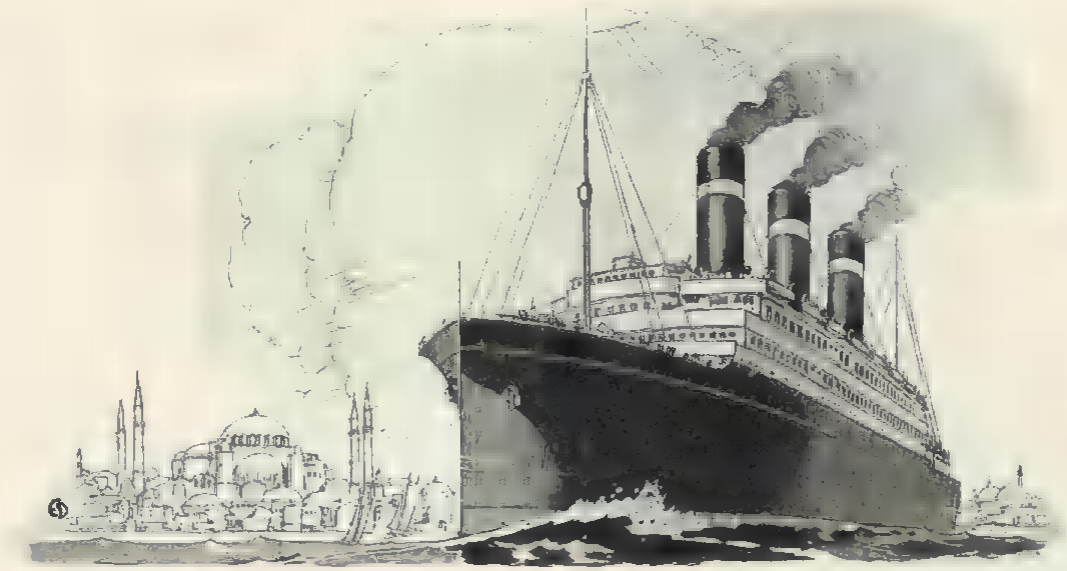

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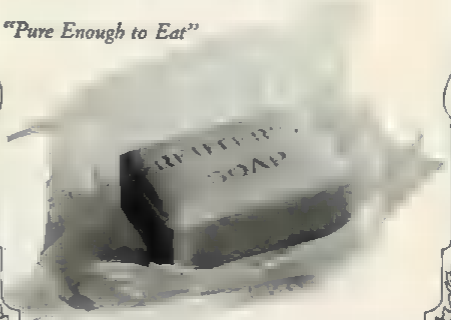

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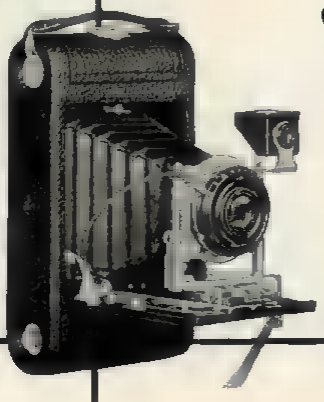

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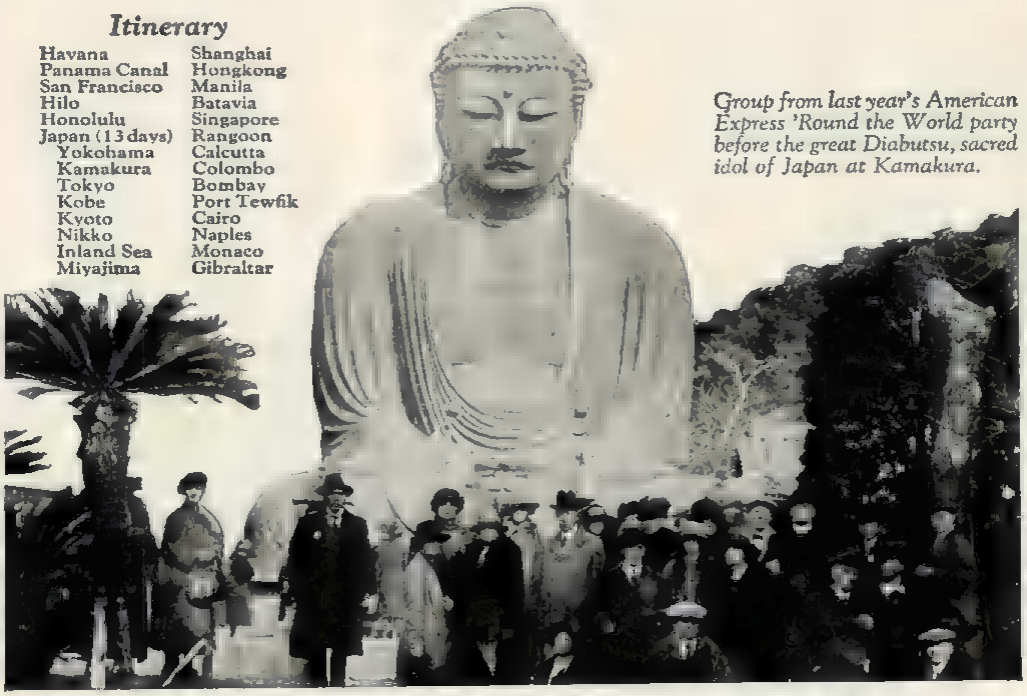

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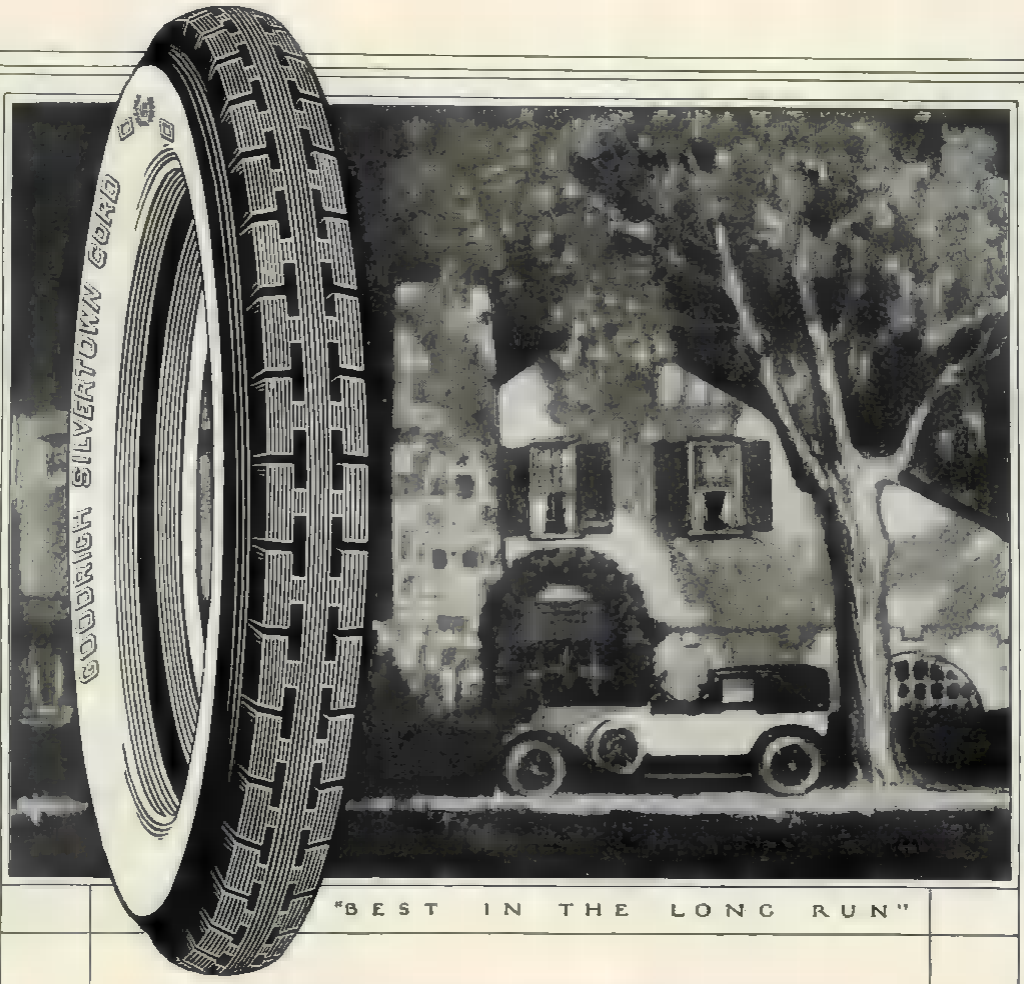

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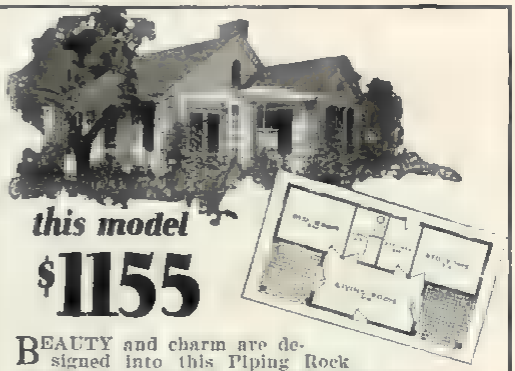

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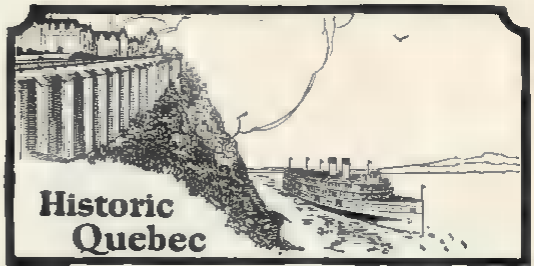

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Remember, statistics are all against you. Science proves that four out of every five have Pyorrhea after forty. For that reason it is good health insurance to start using Forhan's For the Gums today. It is pleasant to the taste.

Forhan's For the Gums is sold by druggists everywhere. 35c and 60c.

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Are You Happy?

ASK a hundred people what they want most in the world and the answer is likely to be —Happiness. To some, Happiness is represented by riches or fame. To others, leisure spells Happiness. But all agree that there can be no real Happiness without Health.

Summer is the time to build for Health and Happiness—the time of vacations. Long days to rest in—to play in—to dream in.

Tom Sawyer and Huck Finn were the ideal vacationists. They took a vacation whether they needed it or not—and had *fun*.

—This is what a real vacation means. To vacate your old environments, your regular occupation —your everyday self and have a complete change. To do the things that will fill you brimful of energy and "pep".

In planning your vacation—and of course you will take one—try to get away from the things you have been doing all year and do the opposite.

The Postman Does Not Need a Walk—

He needs a hammock and a lazy time. The town man needs the quiet of the country—the country man needs the stimulus of the town.

The mountaineer needs the ocean—the lowlander needs the hills. Women who keep house should board—and girls who never see a kitchen throughout the year should camp out and get their own meals.

One man needs solitude —another needs company.

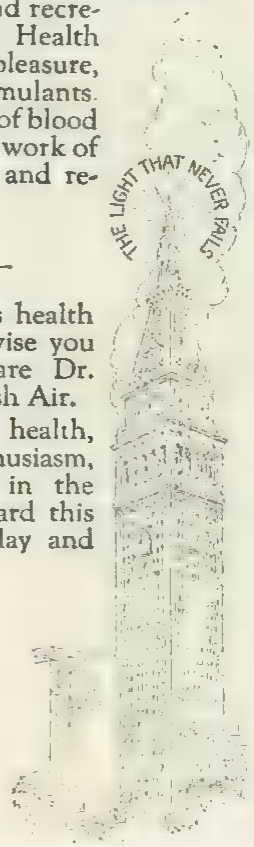
Think of your own needs and plan the vacation that will do you most good.

New ideas—new scenes—new people—all this is recreation. And recreation is necessary to Health and Happiness. Joy, pleasure, laughter are mental stimulants. They increase the flow of blood and so aid in the first work of building up the body and repairing wasted tissues.

Miracle-Workers—

There are two famous health doctors whom we advise you to consult. They are Dr. Sunshine and Dr. Fresh Air.

If you want more health, more energy, more enthusiasm, more earning power in the days to come, play hard this month of August—play and be happy.



During the past few years a great new movement has been growing all over the country —the movement to provide recreation and outdoor amusements for the thousands of men, women and children who live in towns, villages and thickly populated cities. This vacation movement has been carried along by the Metropolitan Life Insurance Company. In 1922 many of our district managers arranged jolly old-fashioned picnics for their local policyholders.

The Metropolitan Life Insurance Company is so strongly in sympathy with this movement that it has prepared a booklet, "What One Town Did", that tells just how to go about the work of providing adequate recreation centers.

Please send for it and help enlist the interest of your neighbors in plans for building health in your town.

HALEY FISKE, *President.*

Published by

METROPOLITAN LIFE INSURANCE COMPANY—NEW YORK

Biggest in the World, More Assets, More Policyholders, More Insurance in force, More new Insurance each year

The Victrola and the great bands of the world

Summer-time is band time. Hundreds of bands are delighting millions of people at the parks and seashore playgrounds of the nations. Here, Sousa's Band, Pryor's Band, and Captain Santelmann with the United States Marine Band; in England, the Band of H. M. Coldstream Guards; in France, the Garde Republicaine Band; in Italy, the Banda Municipale of Milan; in Spain, the Banda de Alabarderos; in Brazil, the Banda do Corpo de Bombeiros; in Mexico, the Police Band of Mexico City.

To record and reproduce the soul-stirring music of a military band is a matter of the greatest difficulty, but with Victor Records played on the Victrola you miss none of the thrills you would get in attending the concerts by these famous bands.

Records by all of these great bands are listed in the Victor Record Catalogs and are on sale by thousands of dealers who will gladly play them for you. You may enjoy them in your home and whenever you choose.

We especially recommend

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Vespri Siciliana—Ballet Selection Vespri Siciliana—Selection	Band of H. M. Coldstream Guards	35434	1.25
Princesse Mignonne	Garde Republicaine Band	67266	.75
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Paquetita—Vals	Banda do Corpo de Bombeiros	69236	.75
Minuet (Military Symphony)	Banda de Alabarderos	62660	.75
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Victor Talking Machine Company, Camden, N.J.

VOL. XLIV, No. 2 WASHINGTON AUGUST, 1923

THE NATIONAL GEOGRAPHIC MAGAZINE

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OUR HERITAGE OF THE FRESH WATERS

Biographies of the Most Widely Distributed of the Important Food and Game Fishes of the United States

BY CHARLES HASKINS TOWNSEND

DIRECTOR OF THE NEW YORK AQUARIUM

With Sixteen Color Plates from Paintings by Hashime Murayama

SINCE the beginning of time mankind has been able to get some part of his food from the waters; among the relics of the Stone Age are shell hooks and stone sinkers. Ancient sculptures—Assyrian, Egyptian, and Aztec—portray the taking of fishes with spear, hook, and net.

The prophet Habakkuk—who knows how many centuries B. C.?—placed some details on fishing in the earliest literature: "They take up all of them with the angle, they catch them in their net, and gather them in their drag."

In some of the far corners of the world amazingly primitive ways of getting fishes are still in use.

In the mountain streams of New Guinea the still-savage native has been found using a dip net made of a hoop fitted with a piece of unbelievably tough spider web.

We have seen the Aleut drag up a heavy halibut with a huge hook of bent wood, the Fuegian make a successful throw with his bone-pointed spear, and the Tonga islander stupefy hundreds of fishes with the juices of a poisonous plant.

The modern Japanese fisher has not yet lost the ancient art of making the cormorant fish for him without the trouble of providing either hook or bait.

As populations increased and man improved his methods, he naturally took more food from the waters and doubtless wasted more; and this he is still doing. His equipment is now enormous and a surplus fish supply often gluts the market, despite cold storage and other means designed to prevent it.

As fish-catching enterprises gradually became great fishery industries, there arose the problems of diminishing supply. The sea fisheries stood the strain so well that some naturalists of the past generation took the stand that the puny efforts of man could not affect the life of the sea; but this view has undergone a change. To-day there are official boards in many countries concerned with the preservation of sea fisheries.

OUR FRESH-WATER FISH RESOURCES ARE CONSTANTLY DIMINISHING

In considering the resources of our fresh waters, we find everywhere exhaustive methods of fishing and a diminishing supply, in spite of restrictive measures and extensive fish propagation.

The means by which diminution is measured are to be found in the fishery statistics of the past half century. The annual yield of products—still very large—can be safely viewed only in com-

FISHING IN SKYKOMISH RIVER NEAR INDEX, WASHINGTON

There are several kinds of Trouts in the waters of Washington State, mostly the "Cutthroat" forms, which are more numerous in the Rocky Mountain region.

Photograph by Eugene J. Hall

FISHING BELOW NIAGARA FALLS

The Great Lakes constitute a vast inland reservoir of fish life, the annual commercial catch sometimes exceeding 100,000,000 pounds.

parison with the continual increase and improvement in the apparatus of capture.

It takes more and more gear to make the same catch. In the Great Lakes, our largest reservoirs of fish food, the investment in the fishery industry now exceeds $10,000,000. The principal fish-catching devices, such as pound nets, fyke nets, and gill nets, practically automatic in operation, are filling day and night as long as the Lakes are free from ice.

The rivers and lakes of the United States have fishery resources that are unequaled elsewhere. The Great Lakes are virtually inland seas and the navigable rivers are among the largest in the world. The mighty Mississippi, with its tributaries reaching in all directions, fairly dominates the map of the country.

These waters, with the rivers of the Atlantic and Pacific coasts and many lakes of the Northern States, have been enormously productive in food for our people.

In one year commercial fishermen alone have taken from the Mississippi River

Photograph by Scenic America Company

FISHING IN CRATER LAKE, CRATER LAKE NATIONAL PARK, OREGON

There were no fishes in Crater Lake until Rainbow Trout were introduced by the Government. Crater Lake is six miles long, four miles wide, and in one place 2,000 feet deep. Its surface is 6,000 feet above sea-level, its steep walls rise from 500 to 2,000 feet above its surface, and it has neither inlet nor outlet that has yet been discovered.

and its tributaries more than 96,000,000 pounds of fish, while the Great Lakes yielded more than 113,000,000 pounds.

Large as are the food supplies of these two regions at the present time, they must have been vastly greater before the exploitation of their resources began. Unfortunately, there are no official records by which the extent of the earlier fishery operations may be measured.

While the fish food derived from our fresh waters is vast in quantity, it is also notable in variety. There are many kinds of Trouts, Salmons, Whitefishes, Sturgeons, Pikes, Basses, Sunfishes, Perches, Catfishes, the Shad and the Eel, as well as the less important, but abundant and widely distributed, Chubs and Suckers.

SERIOUS INROADS BEING MADE ON SALMON AND SHAD

Although the Salmons, Sturgeons, the Shad and other fishes ascending rivers for the purpose of spawning do not remain permanently in the fresh waters, it is here only that they reproduce and may be captured. It is here that they will be preserved indefinitely or utterly destroyed.

None of the rivers of the Atlantic coast contain to-day the great runs of Shad, Sturgeon, and Salmon for which they were noted half a century ago. Along the Pacific coast from California to Alaska the Salmon rivers have been subjected for more than a generation to commercial fishing so exhaustive that the prepared products are distributed by the shipload throughout the civilized world.

In the larger Pacific rivers the migrating Salmons pass up to their spawning grounds more than a thousand miles inland only after the nets of the canneries have taken their heavy toll, amounting to the great bulk of the migrants. The fresh-water crops planted by nature are being gathered at a rate that tends to increase rather than diminish.

When restrictions are proposed by conservationists, the extent of the "investment" is at once pointed out and greater propagation is urged instead. It is difficult to check a going industry, even when it is clear that its future is being imperiled.

The average citizen sees but little of the great fishing operations going on perpetually. The innumerable gill nets, pound nets and fyke nets—all under water and out of sight—work while the fishermen are asleep. From early spring until late autumn they are emptied daily and the heavy catch distributed to the markets of the whole country. In winter the markets continue to supply great quantities of fish withdrawn from cold storage.

We think little about where our fish supplies come from so long as we have them, and Uncle Sam's statistics, even when recording the annual catch in such figures as hundreds of millions of pounds, are but dull reading. It is well to be reminded, however, that the yield of the fisheries grows smaller—not larger.

In addition to the familiar food and game fishes, our waters are rich in Minnows, Darters, Shiners, and other small fry of no direct economic value, but of vast importance as the food supply of larger fishes. Every great watershed has its peculiar forms of these, all well known to ichthyologists, who have described and named them by the score.

Some of our smallest fishes have been found useful in combating malaria and annoyance caused by mosquitoes, and are even being shipped by the United States Bureau of Fisheries to mosquito-plagued foreign countries. There is now in progress much active investigation regarding the value of several species of fishes for the control of the mosquito.

UNITED STATES HAS FIVE TIMES AS MANY KINDS OF FISHES AS EUROPE

The richness of fish life in our fresh waters is amazing. The United States has a smaller area than Europe, yet it has nearly five times as many kinds of fresh-water fishes. We have about 585 species of these, while Europe has but 126 species.

We find that a single State may have considerably more than 100, the number known to Illinois being 150, while New York is credited with 141. It could doubtless be shown that our fresh-water fishery resources are greater than those of any other country.

Many of the fishes commonly taken for food or in sport fishing, and naturally of wide distribution, have, as a result of fish-cultural operations, been established in sections of the country far removed from their original habitat.

Photograph courtesy Noa Spears, © C. O. Lee

A CANNIBAL BASS FALLS A VICTIM TO HIS APPETITE

These two fish were picked up by a boatman while they were still struggling in Medina Lake, near San Antonio, Texas. The large Bass had the entire head of the smaller Bass in his mouth. Hungry Bass sometimes try to swallow fishes larger than they can manage comfortably, even their own species. The cannibal shown above is the Large-mouthed Black Bass. Like the Pickerel, he can digest a particularly large mouthful by inches.

A fish belonging to the Mississippi system or to the Atlantic slope often takes full possession of a new watershed, as the result of mere transplantation of limited numbers. In this way the Shad and the Striped Bass have been made abundant on the Pacific coast—a notable success in fish propagation.

FISHING AS A LURE FOR THE TOURIST

Although the numbers of fishes caught by anglers do not figure in statistics of the catch made for market, they are not without high economic and other values. Most of the Northern States are visited in summer by tourists interested primarily in good angling waters.

Lakes far and wide have become summer resorts for people who find much of their recreation in fishing. Railways and summer resorts widely advertise the resources of their waters. Summer visitors, moving actually by hundreds of thousands, carry into these States millions of dollars. The trade in angling equipment alone is extensive.

Who can measure the health and esthetic values attendant upon the angling idea? Some one has recently asserted that the angling habit is conducive to long life, and, beginning with Izaak Walton, who lived to be ninety, presents a lengthy list of celebrated fishermen who lived well into the eighties and nineties, many of them prominent in the literature of American angling.

FISH PROPAGATION

Modern fish culture has made greater progress in the United States than in other countries, being carried on by the Federal Government and by all of the States which have fishery resources of importance. The output from Government hatcheries alone in 1921 amounted to nearly five billions of fish eggs, young fry, and partly reared fishes, while that from State hatcheries was nearly as great.

The work includes all of the freshwater fishes of importance and a

Photograph by Redner Photo Company

THE CATCH OF ONE ARKANSAS FISHERMAN—112 FISH TAKEN IN TWO NIGHTS AND ONE DAY

All the larger specimens shown here are Catfishes. There is good fishing in the streams of Arkansas; they have contributed to the markets in a single year 500,000 pounds.

Photograph by S. N. Leek

A NATIVE SON AND NATIVE TROUT: WYOMING

The Trout shown here are doubtless one of the numerous species of the Rocky Mountain region, known as Black-spotted or "Cutthroat"—probably the Yellowstone Trout (*Salmo lewisi*) inhabiting the Snake River basin above Shoshone Falls.

number of marine species belonging to the coastal regions or entering the rivers to spawn. The hatcheries, both Federal and State, are distributed north and south from coast to coast.

POLLUTION OF FRESH WATERS A DANGEROUS MENACE TO OUR FISH RESOURCES

Fresh-water fish culture in the United States has been carried on for more than fifty years in steadily increasing volume, in the effort to keep pace with a depletion by fishery industries that constantly threaten exhaustion of the fish supply.

The great fishery problem of the time in our country is the pollution of the fresh waters by innumerable agencies, rapidly affecting their productiveness. Unless stern measures are introduced by law to correct this, soon one of our great natural economic gifts will be seriously stricken.

When we consider that the market catch in the Great Lakes alone sometimes exceeds 100,000,000 pounds a year, that legions of anglers are overfishing the Trout and Bass streams everywhere, and that pollution of the rivers by manufacturing industries has reached appalling proportions, it is apparent that our heritage of the waters is endangered to a serious degree.

Fish culture alone cannot save it, even if greatly increased. We are already wasting expensive propagation work in stocking waters no longer suitable for fish life, and many streams have been abandoned to their fate. One could name a score of rivers in mining and manufacturing States, once contributing to the food supply, that now contain no living thing—no fish or Mussel or Crayfish, not even the air-breathing Frog. These rivers represent damaged resources and there are others that may soon be like them.

Reforms come so slowly that the great cleaning-up task ahead of the American people is not likely to be undertaken seriously until conditions become intolerable. In many countries all wastes available for fertilization are restored to the land and not sent insensately through sewers into the streams, while manufacturing wastes

Photograph by Harry F. Blanchard

HIS TRIBUTE OF THE DAY'S CATCH

are converted into valuable by-products. The exhaustion of our fresh-water resources through overfishing and water pollution is not inevitable. There is now a saving fund of knowledge relative both to propagation and protective measures, awaiting application through the force of aroused and insistent public demand.

THE AUTOMOBILE AFFECTS FISH SUPPLY

A more recent but increasing danger to which angling waters are exposed lies in the ever-increasing use of the automobile. Bass and Trout waters heretofore reached with difficulty have become the easily accessible resorts of camping parties, with the result that their resources are being exhausted.

As a partial offset to such conditions, we may point to the increasing efforts of the United States Bureau of Fisheries in the work of rescuing food and game fishes from overflowed lands in the Mississippi Valley, where appalling numbers of fishes have always perished upon the recedence of floods.

Although a dozen or more crews of five or six men each, equipped with seines, are now employed, many times the present number are needed. The total number

Photograph by E. R. Sanborn, New York Zoölogical Society

THE INCOMPARABLE BROOK TROUT, BEST BELOVED BY THE LIGHT-ROD FLY-FISHER

This fish thrives in cold torrents which grosser fishes do not enter. No part of our outdoor heritage is more worthy of conservation than the rapid Trout waters of the mountains.

of entrapped fishes restored to flowing waters in 1922 exceeded 179,000,000 of all sizes. The larger fishes are removed to adjacent streams, the smaller ones distributed far and wide for the stocking of depleted waters.

Many as are the sportsmen taking toll of our wild life with the gun, those who use the rod are vastly more numerous. It is as easy to exhaust a small stream by overfishing as it is to exhaust the quail supply of a neighborhood. Fortunately, the preservation of the fishes is always possible through the employment of safeguards and restorative measures. Our fishing will doubtless last longer than our shooting.

Private fish culture would be of great service in maintaining and increasing our supply of fish food. While it has been practiced for centuries in some European countries, it has but little more than commenced in America.

The possessors of strongly flowing springs, brooks, and small lakes should be awakened to the value of their home resources for water farming. Approved methods for the construction and management of fish ponds have been worked out at public fish-cultural stations and instructive public documents on the subject can be had for the asking.

Fish-culturists assert that an acre of water can be made to yield more food than an acre of land and the truth of the assertion has been demonstrated.

MUSSELS DEPENDENT UPON FISH HOSTS

An interesting work in aquiculture is now being carried on in the Mississippi Valley under the direction of the Bureau of Fisheries. It is based upon the fact that the propagation of the Mussel is dependent upon the presence of fishes to which the young, free-swimming Mussels may attach themselves as parasites until they are old enough to form shells and begin an independent existence.

The large, heavy-shelled Mussels of this region have been gathered in such numbers for the manufacture of pearl buttons, and also for the valuable pearls they sometimes contain, that the supply is being exhausted and the important industry dependent upon the Mussel is in danger.

The Mussel industry annually yields 60,000 tons of shells which are worth more than $1,000,000. We are all wearing pearl buttons from this source, which will be missed if the great river becomes too foul for the growth of Mussels.

Young Mussels attach chiefly to the gills of fishes, and in some species to the fins, during the early period of their lives. It is now practically certain that all Mussel spawn which fails to find a suitable fish host sinks to the bottom and dies.

The young Mussels are temporarily provided with minute hooks for attachment and are soon enveloped in the epithelium of the fish, where they remain encysted until the shell begins to form and they can safely drop off.

All fishes are not equally susceptible to these temporary mollusk parasites; some receive very few, others shed them too soon, while still others die as a result of carrying too many. Practical work is in progress, and large numbers of fishes "infected," as it is called, with young Mussels are liberated to stock the public waters, as their "parasites" develop and fall off.

The "planting" of the Mussels is, therefore, left to the fishes. It is even possible to send Mussel-bearing fishes to waters outside the Mississippi system and thus introduce the more valuable Mussels elsewhere.

TURTLES, FROGS, AND CRAYFISH

There are several species of large Turtles of the kinds known as "sliders" in our fresh-water streams and lakes, especially in the Middle and Southern States, that contribute to the food supply. They have long been used in filling the ever-widening vacancy in the markets formerly occupied by that favorite of the epicure, the Diamond-backed Terrapin of the salt-water marshes.

They have so high an edible value that it is whispered we often pay Terrapin prices for Turtles that never saw brackish water. Fishery officials are aware of their importance and have studied their distribution, methods of capture, and conservation.

Frogs of several kinds are valued aquatic food delicacies, and their habits have received considerable attention with the view to developing a practical system of frog-culture. It is to be hoped that some method of conservation will be

Photograph by Fred H. Kiser

AMONG THE CHALETS OF THE CUTBANK VALLEY, GLACIER NATIONAL PARK: MONTANA

The United States Government established a fish hatchery in Glacier National Park recently and has planted nearly 4,000,000 fish there in the last two years. The waters of the park abound in Rainbow, Brook, and Mackinaw Trout, Grayling, and Whitefish.

Photograph by Putnam Studios

TROLLING FOR TROUT IN LAKE TAHOE

The Lake Tahoe Trout (*Salmo henshawi*) inhabits several lakes of the high Sierra. It attains a weight of six pounds. There is also a Deep-water Trout in this lake (*Salmo tahoensis*), which is never found in shallow water.

Photograph by William H. Zerbe

ON HIS WAY TO THE HUNTING GROUND OF YOUTH

Photograph by Maynard Owen Williams

FISHING IN THE POTOMAC FROM THE NATIONAL CAPITAL'S WATERFRONT

found before the natural supply approaches the point of exhaustion.

The annual market supply of fresh-water Turtles and Frogs has been known to exceed half a million pounds of each, the great bulk of the catch being derived from the Mississippi and its tributaries.

The humble Crayfish, although of small size, figures prominently in the aquatic food supply, Lake Michigan leading with over 200,000 pounds annually.

FOODS OF FISHES

A subject of perpetual interest to all who fish with the rod is the food of fishes. There are moments in the lives of all of us when the most important thing in the world seems to be how to get the fish to bite. The problem is taken as seriously by the captain of some great industry, off on a fishing trip, supplied with the most expensive tackle, as by the barefooted urchin with a homemade pole, and doubtless the man of business is the more serious of the two.

Thanks to the patient laboratory investigations of Professor S. A. Forbes, this dark question has been made luminous. He tells us that while the food of fishes consists chiefly of other fishes, it includes practically the whole aquatic fauna—a comforting fact when we would seek for baits.

Fishes not only feed on other fishes and on insects, but on crustaceans, mollusks, and worms. Plants do not constitute much of their food, although a few kinds feed on them, such as Buffalo-fishes, Carps, and Minnows. Some fishes get food by rooting in mud, while others are inclined to be scavengers.

Among the chiefly fish-eating fishes may be mentioned Pike, Pickerel, Muskellunge, Pike-perch, Burbot, Gar, Black Bass, and Channel Catfishes. Those taking fish food in moderate amounts are represented by Bream, Blue-cheeked Sunfish, Mud-fish, White Bass, Rock Bass, and Crappie.

Fishes which feed on other fishes to a trivial extent are White Perch, Suckers, Spoonbill, the various Darters, Top Minnows and Silversides, Sticklebacks, Mud Minnows, Stone-cats, and common Minnows. The whole Minnow tribe contributes to the food of the smaller fish-eaters.

In the Mississippi region the Gizzard-shad constitutes 40 per cent of the food of the Wall-eyed Pike, 30 per cent that of

Photograph from U. S. Forest Service

LAKE TROUT CAUGHT IN SUPERIOR NATIONAL FOREST: MINNESOTA

The Great Lakes Trout, or Mackinaw Trout (*Cristivomer namaycush*), inhabits many of the larger northern bodies of water outside the Great Lakes. It is a good game fish, wherever found.

the Black Bass, half that of the Pike, and a third that of the Gars. This is a good illustration of the usefulness of an abundant species of little importance as food for man.

Mollusks—the Snails and Mussels of various species—are also important as fish food. They form large proportions of the food of Catfishes, Suckers, Freshwater Drum, and Mudfish. About 16 per cent of the food of Perches, Sunfishes, Top Minnows, and Shiners is molluscan in character.

Fishes feed freely on insects, not only on the aquatic forms in their various larval and mature stages, but also on terrestrial insects cast into the water in many ways.

Crustaceans appear to be of even more importance as fish food, especially the minute Entomostraca. The Crayfishes are also eaten.

The food of adult fishes naturally differs greatly from that of the young. In addition to natural foods, both alive and dead, fishes in captivity will devour many kinds of meats and prepared foods. The question, then, as to what constitutes the food of fishes may be answered: almost any living animal forms from the water not too large to be swallowed. Therefore if the fish will not take the bait or the fly first offered, it may be tempted with another, and the resourceful angler need not return with an empty creel.

AGE, GROWTH, AND HABITS OF FISHES

Little can be learned definitely about the ages attained by fishes, unless individuals are kept under observation in captivity, either in public aquariums or in the ponds of fish-culturists.

The tagging experiments made on young fishes at Government Salmon hatcheries on the Pacific coast have yielded information as to the ages when these fishes, after attaining maturity in the sea, return to spawn in their native rivers.

As all of the five species of Pacific Salmons perish after their first and only spawning, tagging reveals only the age at breeding maturity, which seems to vary

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CATCHING YOUR FISH AND COOKING IT WITHOUT MOVING FROM YOUR TRACKS

The Yellowstone Trout (*Salmo lewisi*) is very abundant in Yellowstone Lake, Yellowstone National Park. The "boiling pot" is one of the numerous hot-water holes to be found in this region. The surrounding water is cold.

between the fourth and the seventh year, according to the species.

The records of public and private aquariums, however, furnish data that we may consider reliable. The European Eel has undoubtedly lived for long periods in captivity. According to accepted authorities, a few specimens kept in aquariums have lived for periods varying from 20 to 55 years. Boulenger, in the Cambridge Natural History, states that an Eel kept by the French naturalist Desmarest for "upwards of 40 years" reached a length of four and a half feet.

It is recorded that four Russian Sterlets had lived in the private aquarium of Captain Vipan in Northamptonshire for 25 years. He also had a Golden Orfe still living after 24 years of captivity. A record from the Brighton Aquarium is that of a Sterlet which died after having been kept there "about 38 years."

The Australian Lung-fish is known to have lived at the London Zoölogical Gardens more than 19 years.

There are accounts of European Trout said to have been kept in captivity for 53 years, and of Carp still longer, but such are hardly comparable in verity with the records of existing public and private aquariums.

The New York Aquarium still has specimens (1923) of the Mudfish or Bowfin and the Long-nosed Gar which were received in 1903. There are also living Short-nosed Gars brought from the Mississippi River in 1904.

In the Aquarium certain North American fishes have lived for long periods, viz., Striped Bass, 20 years; Whitefish hatched in the building in 1913 are still living; Large-mouthed Black Bass, 11 years; Muskellunge, Calico Bass, Rock Bass, and Yellow Perch, 10 years. The last four were adults when received and are still living.

A Striped Bass kept in captivity for 19 years weighed 20 pounds and was three feet long when it died. Its length when received was about six inches. This species sometimes attains a weight of 80 pounds or more. It is likely that some

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THE "FISHING ROD" OF THE OJIBWAY INDIANS OF NORTHERN MINNESOTA

Most of the northern tribes of Indians are adepts with the fish spear.

species grow faster in freedom, where they find their natural foods, but other kinds may develop faster in suitable ponds, where they are well cared for and protected from enemies.

Wild fishes of exceptionally large size being often found, we may assume that fishes continue to grow through life, the period of life depending largely upon enemies. In a world beset with sharp fangs and claws, the life of a wild animal, either in the water or on land, is apt to end in a tragedy.

TELLING THE AGE OF A FISH BY ITS SCALES

It is now known that the scales of fishes bear marks which indicate the length of life and the rate of growth in different years. Studies of the Atlantic Salmon in Scotland and of the various species of Pacific Salmon have proved this.

Photograph by T. J. Golden

A LAKE CHAUTAUQUA MUSKELLUNGE

This specimen, which was 52½ inches long, with a girth of 24½ inches, weighed 42 pounds (see text, page 157).

The scale grows in proportion with the rest of the fish, principally by additions around its border. The fish grows at different rates during different seasons of the year. Concentric ridges form around the edge of the scale, its marginal expansion in summer being more rapid than in winter, so that the growth during each year is usually distinguishable. (See illustration, page 153).

Studies of the five species of Pacific Salmons have shown the ages at which the different species return to the rivers to spawn. Thus, the ridges on a fish's scales are comparable to the annual ring growths revealed on a cross-section of a tree trunk, which tell its age.

It is interesting to note that the "tagging" of young Pacific Salmons, previously referred to, has already served to indicate that, after attaining maturity in the sea, each returns to spawn in the identical stream in which its life began.

Studies of the scales of Whitefishes in the Great Lakes have shown that the scale characters are so well defined that they indicate the age of the individual fish and the rate of growth of the species.

Scales from Whitefishes hatched and reared in the New York Aquarium and therefore of known age (see illustration, page 131) have been used by Government biologists in checking the results of studies of the scales of wild fishes.

The sexes of fishes are not as readily

Photograph by E. R. Sanborn

YOUNG SMALL-MOUTHED BLACK BASS WINTERING IN AN AQUARIUM

The fish remain poised in mid-tank, crowded closely together. As long as plants can be kept growing in the cold water the fish will pack themselves tightly among them. While the temperature of the water remains low, the fish seldom take food.

distinguishable as in the case of birds. Males and females are usually so much alike that only the expert recognizes the differences, and in many species the dissecting knife must be employed to determine the fact.

The colors of fishes vary somewhat according to the waters which they inhabit, and this applies also to fishes held in captivity, where their colors tend to become more subdued. The fishes of exhibition tanks, however, brighten their colors during the spawning seasons, much as do wild fishes.

The habits of fishes have not been studied as thoroughly as have those of birds, mammals, and other vertebrated animals. Books on fishes are largely of two classes: those written by anglers, relating chiefly to methods employed in the capture of the fish, and those written by the systematic naturalist, dealing chiefly with classification and distribution.

In neither class of books is the life of

Photograph by E. R. Sanborn

THE AMATEUR FISHERMAN'S DELIGHT: ROCK BASS

Whatever it may lack in reputation among scientific fishers, this species is one of the most popular among average anglers. From the St. Lawrence to Texas, the legion of the unskilled easily transfer it from its rocky haunts to the frying-pan.

the fish in its own environment very fully considered. There are, of course, satisfactory life histories of certain common species, especially those inhabiting the smaller streams, and fish-culturists are contributing new information on the ways of fishes reared in ponds.

Since the keeping of fishes in aquariums became common, many important facts have been recorded, but observations on creatures in captivity can manifestly deal with but little of their real life.

For many important facts relating to the senses of fishes we are indebted to the modern biological laboratory. Facts based on scientific experiment relative to fishes' powers of hearing and memory, their color changes, sleep, electrical and poisonous properties, the sounds they make, and so on, are slowly being brought to light.

The naturalist who can devote himself to the observation of the ways of fishes will find a fascinating field and contribute new facts to science.

SPOTTED CATFISH (Ictalurus punctatus), COMMON BULLHEAD (Ameiurus nebulosus) and other Catfishes

(For illustration see Color Plate I)

There are many kinds of Catfishes in the United States, all of which belong naturally to that part of the country lying to the east of the Rocky Mountains, those now abundant in some States west of the Rockies having been introduced.

Catfishes are of considerable importance commercially. The fishery statistics of a few years ago show that the annual catch for market exceeded 14,000,000 pounds, but to-day the supply is much smaller.

Being easy to catch, the total of those taken everywhere with hook and line can only be conjectured, but it may possibly equal the quantity yielded by the net fisheries.

As Catfishes in general have the habit of guarding their nests and protecting the young, the supply holds out well in spite of exhaustive fishing. Such habits also as feeding chiefly at night and feeding but little in winter contribute to their preservation

The Blue Catfish, inhabiting the Mississippi Valley, is the largest and best of all as a food-

Photograph by E. R. Sanborn

THE EASTERN PICKEREL IS WIDELY DISTRIBUTED

This species inhabits every State east of the Alleghenies, where there are lakes, ponds, and slow streams. Bass and Trout fishers do not praise it, but thousands of others take it thankfully.

fish. It occasionally attains a weight of 125 pounds and 80-pound specimens are not uncommon, but like other fishes taken in large numbers, the average weight is only a few pounds.

The Blue Catfish is less inclined to live in muddy waters than some other species, preferring the clearer and swifter streams. It is a clean feeder, living much on fishes and Crayfish. As a game fish it is one of the best in the Catfish family, taking many kinds of baits, and is a strong fighter on the line, but never adds to the angler's thrill by leaping from the water.

The Blue Catfish is decidedly given to migratory movements according to seasonal changes in temperature, gathering in the more southerly parts of its range in winter.

The Spotted Catfish (*Ictalurus punctatus*) belongs in the Mississippi Valley and the Great Lakes. It does not reach the size of the Blue Cat, seldom weighing as much as 25 pounds. Like the Blue Catfish, it is a trim and active fish. There are four species in this genus, all having forked tails.

One of the best-known Catfishes is the Common Bullhead (*Ameiurus nebulosus*) inhabiting streams, lakes and ponds of the Eastern and Middle States and distributed as far westward as the Dakotas and Texas. Another fish of this round-tailed genus is the Black Bullhead (*Ameiurus melas*), having much the same distribution. The Bullheads are easily raised in ponds, and under proper management yield a good supply of white and palatable fish food. All of our native Catfishes have tough, scaleless skins and small eyes, and all have eight barbels or feelers on upper and under sides of the mouth, which are useful in searching for food in the muddy waters that many of them inhabit.

Catfishes make their nests usually in sheltered spots, such as can be found under rocks, submerged logs, and stumps, and do considerable excavating in enlarging them. They are spring-time spawners. The eggs hatch in a few days and the young stay with the parent fish until about an inch long.

Catfishes in general are omnivorous, feeding on animal life, and are not averse to downright scavenging. They are very hardy and few fishes can live longer out of water. As they have dangerous spines on dorsal and pectoral fins, fishermen soon learn to handle them circumspectly.

As kept in tanks, Catfishes become nearly dormant when the water turns cold. A 60-pound Mississippi Catfish (*Leptops olivaris*), which lived in captivity several years, took no food during the winter months and remained practically motionless.

The name Channel Catfish is a term rather loosely applied by fishermen to several of the larger fishes of large streams.

Fully a dozen of our numerous kinds of Catfishes are important as food.

Photograph by E. R. Sanborn

TEN-YEAR-OLD WHITEFISHES

These specimens were hatched in the New York Aquarium. Being the only Whitefishes of known age available, scales from them are used by biologists in checking the results of studies of the ages of wild Whitefishes (see text, page 127).

THE BLACK BASSES (Micropterus dolomieu and Micropterus salmoides)

(For illustration see Color Plate II)

The two closely related Black Basses are easily distinguished by the size of the mouth and by the color pattern. In the Small-mouthed species the upper jaw does not extend beyond the eye, as in the case of the Large-mouthed Bass; in the former there is much dark blotching, which tends to form short vertical cross-bands, while the latter has usually a dark band along the side.

The expert angler thinks he can distinguish the species he has hooked before seeing it, as the Small-mouthed Black Bass is by far the gamier and more active. Its reputation as a game fish is not surpassed by any other of its size.

Although the Black Basses are cultivated and distributed both officially and by private effort, they are not fishes whose mature eggs can be stripped by hand and developed in hatchery buildings by wholesale methods. Their propagation is effected by the more natural but slower method of pond culture, in which the fishes are provided with the conditions most favorable to their mating and the rearing of their young.

The same limitations in culture apply to all fishes of the Bass-Sunfish family, which have the habit of making nests and protecting their young.

The Small-mouthed Bass is the fish that pond-owners find most satisfactory and they are justified in the selection. Much of its present wide distribution is due to this fact.

This truly American fish has been much written about and naturally has many names in its extensive range, but Small-mouthed Black Bass is the most widely used as well as the most distinctive. It is found from Lake Champlain, through the Great Lakes to Manitoba, along the Atlantic slope to South Carolina, throughout the upper Mississippi Valley, and in the lakes of southern Canada.

The size of the Small-mouthed Bass depends largely on the waters it inhabits. Fishes of four or five pounds are decidedly large. There are records of specimens still larger, but the angler of to-day in our overfished streams and lakes is well content with a two-pounder.

The Black Basses defend their eggs on the spawning nests with great vigor and it is the male that assumes this task, the female deserting as soon as the eggs have been deposited. His care is continued for a few days after the young appear, when they begin to scatter.

The Large-mouthed Black Bass has a wider distribution than the Small-mouthed species, especially southward, extending into Florida and other States along the Gulf coast. It is in general more abundant and inhabits more sluggish waters.

In the North the two species are commonly

found together. The Large-mouthed species is decidedly larger and in Southern waters sometimes exceeds 12 pounds in weight, but average weights are two or three pounds.

This fish has even more names than its relative, but Large-mouthed Bass serves to identify it wherever the two are found together. As a popular game fish, we are safe in placing it next to the Small-mouthed Bass.

The Black Basses are carnivorous fishes, the young feeding largely on insect life, the adults on fishes, Crayfish, and Frogs. In bait fishing these foods, together with the larger insects and their larvæ, are all used. Expert anglers take both species successfully with trolling spoon and artificial fly.

ROCK BASS (Ambloplites rupestris)

(For illustration see Color Plate III)

Among the native fresh-water fishes living in the Aquarium there are few that adapt themselves more readily to the conditions of captivity than the Rock Bass. In a tank now containing fifteen specimens, mostly of large size, there have been no losses for several years.

The natural range of this fish includes the Mississippi Valley, the Great Lakes, and Lake Champlain drainages, but it has been introduced through fish-cultural operations into many States east of the Alleghenies. Its adaptability to pond cultivation will ultimately extend its distribution.

The methods of the expert angler are not at all necessary for the capture of the Rock Bass. Great numbers are taken by amateur fishers wherever it abounds and during the greater part of the year.

In its feeding habits the Rock Bass is about as omnivorous as any member of the Bass-Sunfish family, to which it belongs. Crayfishes and other fresh-water crustaceans, aquatic insects and their larvæ, Snails, and such fishes as its rather large mouth will admit, all contribute to its natural food supply. If we include the grasshoppers, crickets, grubs, earthworms, and other terrestrial baits used in catching it, the food list might be considerably extended. Fish-culturists have found that this species not infrequently cannibalizes to some extent on its own young.

In addition to the baits already mentioned, the trolling spoon and other artificial lures are used successfully; but the Rock Bass has few of the fighting qualities of the Black Basses, for it soon yields to the pull of the line.

The Rock Bass is a thick-bodied, meaty fish, and a couple of fair-sized ones will fill the pan. There are specimens in the Aquarium a foot long that have nearly trebled in size since their arrival, six years ago. It is known, however, to grow somewhat larger.

At spawning time, late in May, the Rock Bass makes its nest in shallow water along shore, like Basses and Sunfishes generally. The fishes are sociable at this time and their nests are often found in groups close together, which is not the habit with the pugnacious male Black Basses.

CALICO BASS (Pomoxis sparoides) and CRAPPIE (Pomoxis annularis)

(For illustration see Color Plate IV)

The Calico Bass belongs naturally to the region including the Great Lakes and the Mississippi Valley. Being a good food-fish and well adapted to cultivation in ponds, its distribution has been considerably extended by artificial means.

Like other widely distributed fishes, it has several names, one of which, Black Crappie, is sometimes used to distinguish it from its nearest relative, the Crappie or White Crappie. Both kinds are found in the above-named region, but, being of similar appearance, anglers do not always recognize the differences.

The Calico Bass has a relatively deeper body, is darker than the Crappie, and weighs more as compared with a Crappie of the same length. Naturalists easily distinguish them by their dorsal spines, the Calico Bass having seven or eight, while the Crappie has five or six.

The name Calico Bass is suggested by its markings, the Crappie being always paler. Both kinds are found in Western markets. The annual market catch in the Mississippi Valley, of the two combined, sometimes exceeds 1,000,000 pounds. The Calico Bass is chiefly a feeder on aquatic insects and their larvæ. It lives peaceably with other fishes when kept in ponds. So many are taken by anglers that it has been called "the fish for the millions."

If the Calico Basses which have lived in the Aquarium for 10 years continue to thrive in captivity, it will be interesting to see what size they attain with increasing age. Exceptionally large specimens have been reported as exceeding two pounds in weight.

WHITE PERCH (Morone americana)

(For illustration see Color Plate V)

There are few native fishes that live equally well in fresh or salt waters. The White Perch, living chiefly in brackish tidal waters, ranges freely into both. In rivers it passes up beyond all trace of salinity and often becomes landlocked in strictly fresh ponds, where it breeds for considerable periods. On the other hand, it is taken in abundance about coastal islands where conditions are altogether those of the salt sea.

In aquariums it has been kept for long periods in tanks, either fresh or salt, but the best results have been obtained in tanks supplied with both kinds of water. There are specimens now living in such artificially maintained brackish water that are 10 years old. They have reached lengths of 10 to 12 inches and continue to be hardy under the restrictions and the monotonous fare of life in captivity.

Years ago specimens of live White Perch intended for exhibition were obtained from one of the park lakes in New York City where they had been introduced; but, although fully protected, the supply gradually diminished to the vanishing point. It would seem, therefore, that the race cannot breed indefinitely in fresh

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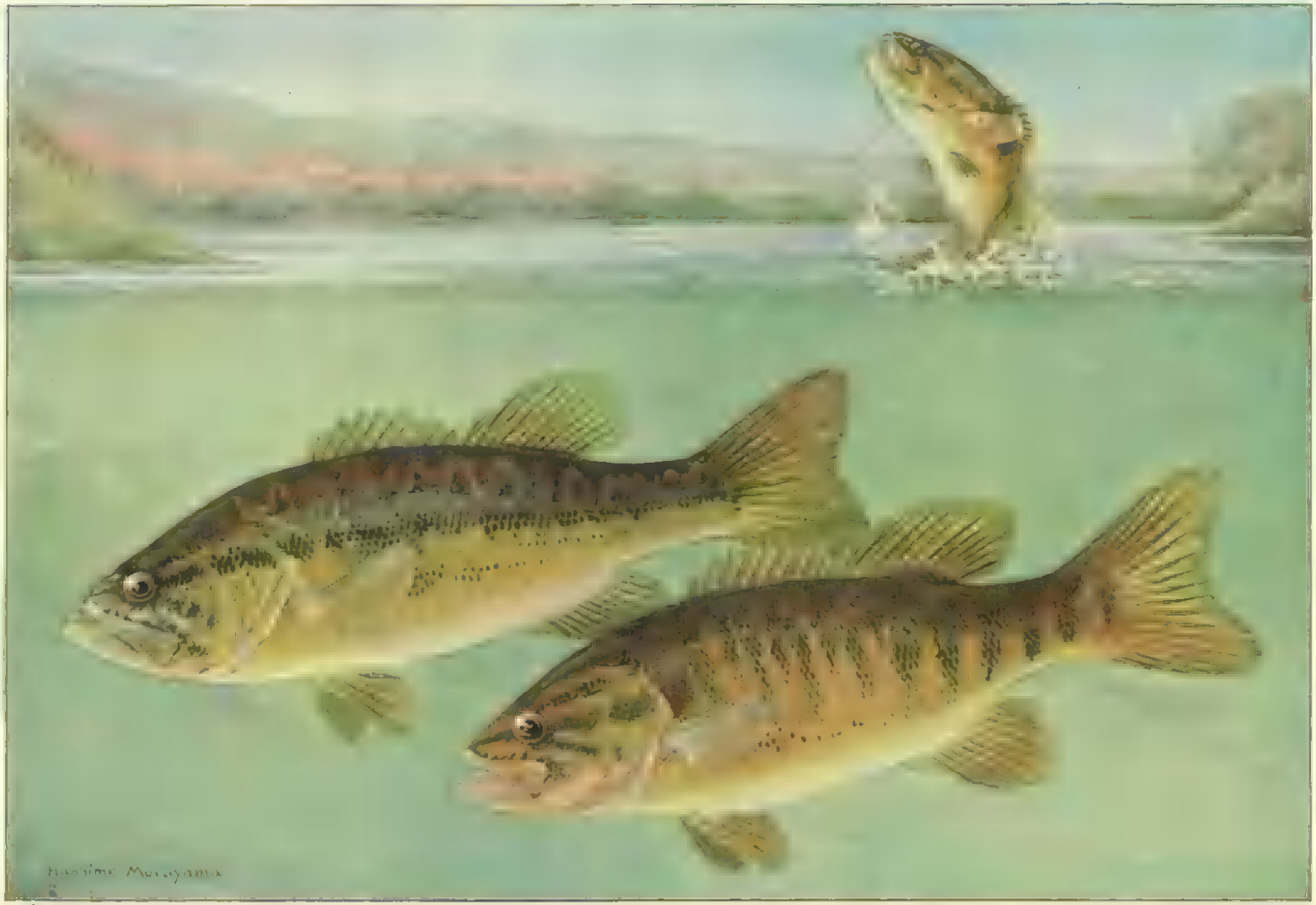
SPOTTED CATFISH (*Ictalurus punctatus*) [at top]; COMMON BULLHEAD (*Ameiurus nebulosus*) [in middle at left], AND OTHER CATFISHES

There are many kinds of Catfishes in our waters, and they are abundant enough to be of considerable importance in the supply of food fishes. The annual catch for market has been known to exceed fourteen million pounds. Great numbers are also taken everywhere with hook and line.



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LARGE-MOUTHED BLACK BASS (*Micropterus salmoides*) [upper]; SMALL-MOUTHED BLACK BASS (*Micropterus dolomieu*) [lower]

The Black Basses are both well-known anglers' fishes, the Small-mouthed species being by far the gamier of the two. Although closely related, they are easily distinguished by the size of the mouth and by the color pattern; in the Small-mouthed Bass the upper jaw does not extend beyond the eye as in the Large-mouthed species. In the former the color markings tend to form vertical bands, while the latter has a dark stripe along the side.

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ROCK BASS (*Ambloplites rupestris*)

This fish is well known in the Mississippi Valley and the States bordering on the Great Lakes. It is valued for both food and sport. Great numbers are taken by amateur fishermen wherever it abounds, and it can be caught during the greater part of the year. A couple of fair-sized Rock Bass will fill the frying pan. A name often applied to this fish is "Red-eye."

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Painted by Hashime Murayama

CRAPPIE (*Pomoxis annularis*) [upper]; CALICO BASS (*Pomoxis sparoides*) [lower]

These fishes belong chiefly to the Great Lakes region and the Mississippi Valley. They are much alike in appearance, but the Calico Bass has seven or eight dorsal spines, while the Crappie has five or six. Both are fine sport fishes and both are handicapped with many local names.

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WHITE PERCH (*Morone americana*)

The White Perch belongs to the Atlantic coast region, and is one of the few fishes that live in both fresh and salt waters. It not only ranges far up the rivers, but is taken in abundance by net fishermen along the coast. The White Perch is good eating whether from fresh or salt water and anglers take it with all sorts of baits. It sometimes reaches a weight of two pounds.

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BROOK TROUT (*Salvelinus fontinalis*)

This is doubtless America's favorite game fish and the one most written about. It is not only much sought by anglers, but is raised by fish-culturists for the fancy price it brings in the market. Over-fishing, deforestation and water pollution all contribute toward the steady reduction of its numbers and the restriction of its range.

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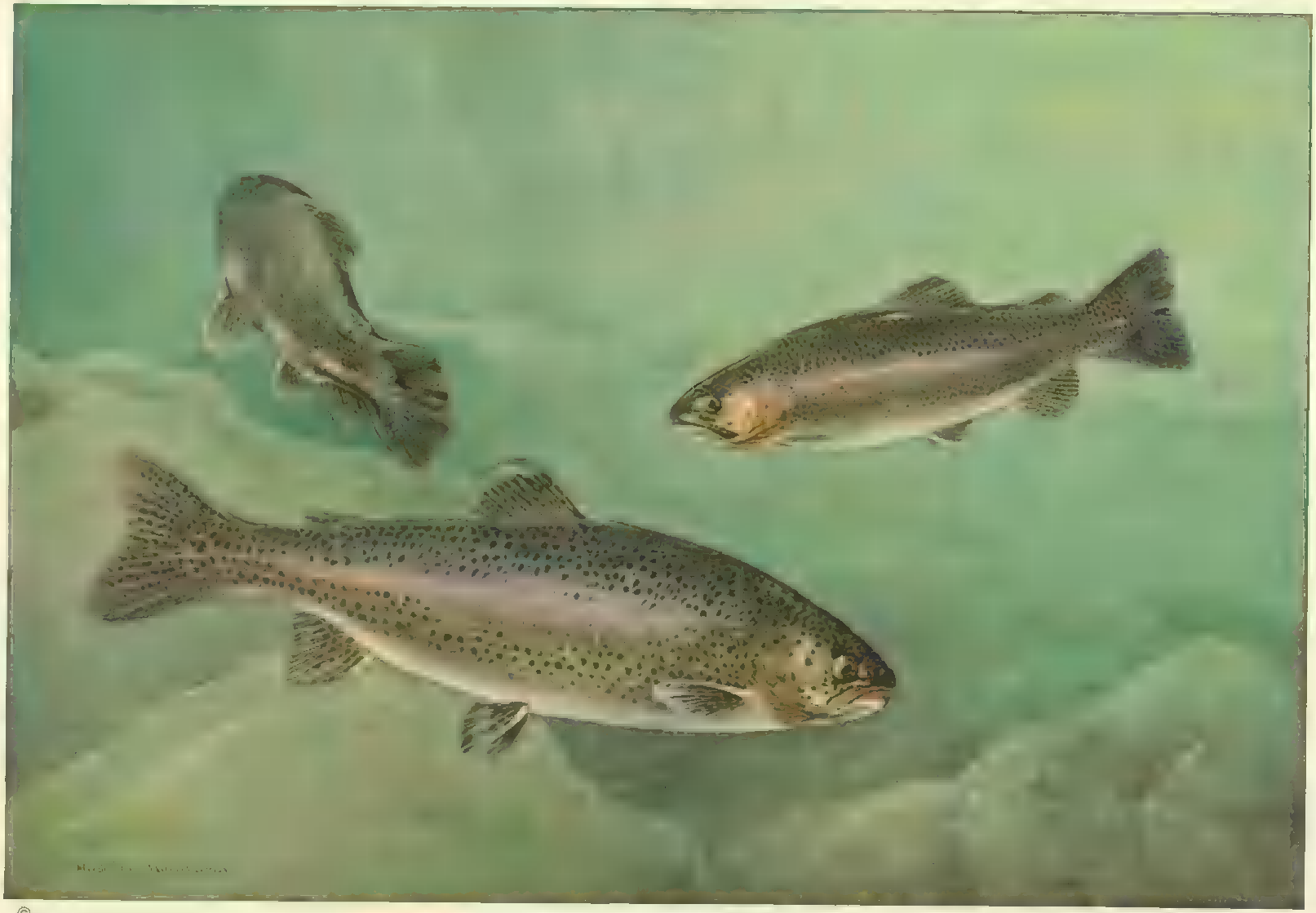
LAKE TROUT (*Cristivomer namaycush*)

This is the largest of all Trouts, having been known to reach a weight of one hundred pounds. It ranks next to the Whitefish in commercial importance; the total annual catch in the Great Lakes recently exceeded thirteen million pounds. Anglers take many in the lakes of Maine, where it is called "Togue."



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McCLOUD RIVER RAINBOW TROUT (*Salmo irideus shasta*)

The Rainbow has been introduced into most of the Eastern States. It is larger than the Brook Trout and can live in warmer water. Although anglers do not consider it quite so gamy, it is a valuable sport and food fish, especially useful in stocking waters no longer suitable for Brook Trout.

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PIKE (*Esox lucius*) [upper]; EASTERN PICKEREL (*Esox reticulatus*) [lower]

The Pike of North America is probably not distinct from the Pike of the Old World. Specimens have been taken weighing over forty pounds. The Eastern Pickerel is the largest of our three species. Both Pike and Pickerel are valued as food and game fishes and like the Muskellunge are exceedingly voracious.

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Painted by Hashime Murayama

LAKE STURGEON (*Acipenser rubicundus*)

The history of the Sturgeon is a story of wanton waste. When the fisheries of the Great Lakes were first being exploited, the Sturgeon was destroyed as useless. Now that its great value is recognized, it may be too late to save it from extinction, as fish-culturists have not been able to solve the problems connected with its propagation. The Sturgeon is valued chiefly for the caviar made from its eggs.

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Painted by Hashime Murayama

LAKE CHAUTAUQUA MUSKELLUNGE (*Esox ohiensis*)

There are three species of Muskellunge, the one shown here inhabiting Lake Chautauqua and the upper Ohio River system. All are Northern fishes, much alike in habits. The Muskellunge is the largest of the Pike family and in the Great Lakes has been known to exceed eighty pounds in weight. It is celebrated as a game fish having both size and strength. In bringing to gaff a large Muskellunge, the angler must put all his dexterity into full play.

©

Painted by Hashime Murayama

COMMON WHITEFISH (*Coregonus clupeiformis*)

This is one of the most abundant and valuable of our food fishes, and with other Whitefishes one of the most important fresh-water fishes in the world. Over twelve million pounds of Whitefish have been taken in the Great Lakes in a single year. The Whitefish is the subject of extensive propagation by the Government.

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Painted by Hashime Murayama

FRESH-WATER DRUM (*Aplodinotus grunniens*)

This large fish of the Great Lakes and the Mississippi Valley is of considerable importance in the market fisheries, but of little interest to anglers except in the South. It is related to the Sea Drum and makes the same drumming sounds. It has heavy grinding teeth like the sea variety and feeds chiefly on Mollusks and Crayfish. Anglers take it best with Crayfish bait.

©

Painted by Hashime Murayama

YELLOW PERCH (*Perca flavescens*)

Found throughout the Northern and Eastern States, this is one of our best-known fishes. It is caught by anglers of all ages, and great quantities are taken for market with nets. Among the commoner fishes there is none of better flavor. It comes as near being everybody's fish as any other.

©

Painted by Hashime Murayama

SAUGER (*Stizostedion canadense*) [upper]; PIKE-PERCH (*Stizostedion vitreum*) [lower]

The Pike-perch, often called "Wall-eyed Pike," belongs to the Perch family, although its form is suggestive of the Pikes. It has been known to reach a length of three feet. In commercial importance, it ranks next to the Whitefish and the Lake Trout, millions of pounds being taken in the net fisheries of the Great Lakes. Anglers find the Pike-perch a good game fish. The young are liberated from Government hatcheries by hundreds of millions. The Sauger has the same northerly distribution as the Pike-perch. It resembles it in appearance, but is smaller and of less commercial importance.

© Painted by Hashime Murayama

COMMON EEL (*Anguilla rostrata*)

The Eel is a fish that spends its long life in fresh water, descending to the sea in old age to spawn but once and die. For centuries its mysterious ways have puzzled naturalists who have discovered recently that it spawns near the Bermuda Islands in deep water, the transparent larval Eels not seeking the rivers until a year old, when they appear as Elvers working upstream.

waters, but must renew its fertility through occasional baths in the vitalizing sea.

Complete exclusion from the brackish or fresh waters, where it spawns, would doubtless lead to extermination as readily as long-continued imprisonment in absolutely fresh water. According to the records of anglers, the largest specimens are those taken in salt or brackish waters.

The White Perch belongs to the tidal region of the Atlantic coast from Nova Scotia to South Carolina. It is abundant around Long Island and in the Hudson River up as far as Albany. It is taken through the ice in the Hudson, where it is present throughout the year.

It is equally abundant in the Delaware and Susquehanna rivers and Chesapeake Bay, ranging well upstream, and is commonly taken in pound and fyke nets along the coast.

In North Carolina the annual catch amounts to 1,000,000 pounds. Anglers catch it in abundance and net fishermen keep the markets well supplied with it. Fishery statistics show that the market catch along the Middle Atlantic States sometimes amounts to 2,000,000 pounds a year.

The White Perch is good eating, either from fresh or salt water. Hook-and-line fishers find Shrimp bait the best, but it responds readily to Minnows, young Eels, small Crabs, or any of its natural foods. Specimens of two or three pounds are reported from the eastern end of Long Island. In fresh waters, worms, grasshoppers, and other insects are effectively used.

The White Perch rises to the fly, especially in fresh waters, and resists bravely when hooked. A fish a foot long weighs about two pounds, but this is larger than the average.

It is a gregarious species, usually frequenting the shallower waters along shore. Spawning begins soon after the ice leaves and lasts a couple of months. Females have been taken with eggs as late as June 10. Fish-cultural experiments have shown that the eggs can be hatched artificially in from three to five days.

Considering the adaptability of the White Perch to the conditions of captivity, especially in brackish water, there is reason to suppose that it will receive more attention from fish-culturists than it has in the past. Anglers would know it better if its range extended farther inland.

BROOK TROUT (Salvelinus fontinalis)

(For illustration see Color Plate VI)

The Brook Trout is the favorite game fish of America. Originally found from Labrador westward to the Saskatchewan and southward along the Alleghenies to Georgia, it has been carried by fish-culturists to the Rockies, the Sierras, the upper Mississippi Valley, and wherever rapid streams of suitable temperature are found.

It has almost disappeared from lowland streams in the North, which have become unsuited to it as a result of deforestation and water pollution.

The Brook Trout persists in small coastal streams where the conditions favorable to it have not been disturbed, and it often descends to brackish water. It will live in streams having a summer temperature as high as 70°, provided they have swift currents.

The Brook Trout cannot live through the summer in the New York Aquarium without the aid of refrigerated water, although the city supply is derived in part from the Catskill Mountains and flows 100 miles underground. The Brook Trout will live in cool lakes and ponds, but cannot reproduce in such situations without access to the gravelly beds of running brooks at spawning time.

Trout culture in America dates back to the early fifties. Fish-culturists raise great numbers of Brook Trout, both for market and for distribution in small artificial ponds, by feeding the fishes and caring for the eggs in hatchery troughs provided with flowing spring water.

The instinct to move upstream is very strong in young Trout; when a miniature "fishway" with its stairs of tiny box pools is connected with a hatching trough, they will promptly begin to ascend and cannot, in fact, be kept down while water is allowed to flow through it.

The Brook Trout spawns in the fall, when streams begin to cool, but the eggs do not hatch out until springtime brings higher temperature. The hatching period lasts from three to six months, according to latitude and altitude. The Brook Trout spawns when two years old. Larger and older fishes deposit from 500 to 2,000 eggs.

In lakes where there is an abundant food supply, the Brook Trout has in the past been known to reach the rare weight of 10 pounds; but to-day, when thousands of anglers are whipping the Trout streams, a one-pound Trout is a large one. Many good Trout waters have been ruined by the ill-advised introduction of predatory fishes.

The coloration of the Brook Trout is extremely variable. In some waters the fish may exhibit all the brilliancy of which it is capable, while in another watershed not far away it is so dark that but little color is discernible.

A notable illustration of this is found on Long Island, the Trout on the south side of the island being among the showiest of the species, while those of the north side are as dark as the Brook Trout ever becomes, although the supply on both sides is maintained by hatchery-raised fishes. After a few months in captivity, the bright colors of the former tend to disappear, while the latter become somewhat paler. This may be due largely to a change in diet and the exclusion of direct sunlight from the tanks.

In the Trout, as in many other fishes, the colors vary with age.

In streams the Brook Trout is largely a feeder on aquatic insects, while in lakes and ponds it feeds much on small fishes. In the Aquarium it subsists cheerfully on chopped fish, like the other captives of the tanks, and in the average hatchery pond becomes a fat liver-fed gourmand.

The Brook Trout is not a leaping fish, like the Bass, when hooked, although it may rise clear of the surface in striking the fly.

We need not describe methods of capturing the Trout; anglers have been writing of this in great detail since the days of the Father of Anglers. No native game fish is more worthy

Photograph by E. R. Sanborn

A STRONG FIGHTER ON THE LINE: McCLOUD RIVER RAINBOW TROUT

This McCloud River variety is the stock from which our introduced California Rainbow Trouts were derived. It is more given to leaping than the Brook Trout.

of protection in the waters still suited to it than the Brook Trout.

LAKE TROUT (Cristivomer namaycush)

(For illustration see Color Plate VII)

The Lake Trout of the Great Lakes belongs chiefly to the fish trade. In these inland seas the angler's share is small in comparison. It is the largest of all Trouts and is known to have reached a weight of 100 pounds. The average of those taken in the gill nets used at the present time weighs less than 10 pounds, while those caught by anglers along shore average but half that weight. The writer once accompanied a northern Alaska expedition, a member of which brought into camp specimens of this Trout exceeding three and a half feet in length. They were taken in a large lake at the headwaters of the Kowak River, above the Arctic Circle, where they were very abundant.

Among our fresh-water fishes the Lake Trout ranks next to the Whitefish in commercial importance. It is found throughout the Great Lakes and from there northward, in all the large lakes of British America and Alaska.

A deep-water form of this Trout, called Siscowet, is taken in great numbers in Lake Superior, the gill nets being set at times in depths exceeding 500 feet and lifted by steam power. The writer once made a cruise north of the Apostle Islands on a steam fishing boat operating 40 nets, each 600 feet long. These were set in one "gang," constituting a single net more than four miles in length.

Each deep-water fishing boat attends to four or five of these great nets. As the net is lifted by the windlass forward, it is carried aft in sections, put together again, and paid out over the stern. The nets were about eight feet wide, with four and a half inch mesh.

The largest of the deep-water Lake Trout taken by our vessel was two feet ten inches long and weighed 21 pounds.

It would be interesting to know the greatest depth at which Lake Trout have been taken, as Lake Superior, one of the deepest lakes in the world, has depths exceeding 1,000 feet and its bottom is far below sea-level.

Some time later a day was spent on a steam fishing boat in the Georgian Bay near its connection with Lake Huron, and the lifting of a gill net six miles in length was observed. It was set at a depth of 100 feet and the work of lifting and resetting occupied five hours. The catch was nearly 1,000 pounds of Lake Trout, the largest of which was three feet long and weighed 15 pounds.

There are many steam vessels in the Great Lakes engaged in such wholesale fishing, as long as the Lakes are free from ice. The annual net catch of Lake Trout in the Great Lakes in 1917 exceeded 13,000,000 pounds.

The writer has taken Lake Trout in the Georgian Bay at depths of about 50 feet with hand line and trolling spoon, but the sport would have been better had rod and reel been used. Anglers who have used the rod with 300 feet of line and Minnow bait find that the fish can be played in a satisfactory manner.

Surface trolling, when the Trout are found in shallower waters, affords better sport. In smaller and shallower lakes, like those of Maine, where summer water temperatures are higher than in the Great Lakes, the Lake Trout is often taken with the fly. In Seneca Lake, in New York State, it is taken with a special trolling rig designed to play the spoon 10 or 20 feet under the surface.

The Lake Trout is easily distinguished from other Trouts by the numerous small, pale-yellowish spots which cover its body from head to tail. It is a voracious fish. Forbes tells of a 20-pound Lake Trout which had 13 good-sized Lake Herring in its stomach.

Lake Trout fry are turned out by the fish hatcheries in great numbers. The spawning season varies in different lakes. Five or six thousand eggs are stripped from fishes of ordinary size, but large specimens yield many more. The eggs hatch in from two to three months.

The Lake Trout endures captivity very well; the Aquarium has 20-inch specimens received in 1919, some of them perfect albinos with bright pink eyes.

Several names are applied to the Lake Trout, one of which is Mackinaw Trout. In the lakes of Maine it is called Togue, while in Canadian lakes it goes by the Indian name Namaycush.

McCLOUD RIVER RAINBOW TROUT (Salmo irideus shasta)

(For illustration see Color Plate VIII)

The Rainbow Trout belongs to the Pacific slope of the Sierras and Cascades; wherever it is found to the eastward of these ranges it is an importation.

There are several geographic races of this Trout, the one now found in Eastern streams and lakes being the northern California variety, *Salmo irideus shasta*. Commencing in the early eighties, the original stock was widely distributed from the Government hatchery on McCloud River south of Mount Shasta. It was the writer's good fortune to be attached to this station years ago and to participate in its work.

The acclimatization of this fish in other parts of the United States and in foreign countries is one of the notable successes of modern fish culture. Taken to New Zealand in the late eighties, it soon became well established there.

The introduction of the Rainbow Trout in Eastern States provided a substitute for the Brook Trout in many waters which had become unsuitable for that species, as a result of advancing civilization.

While generally not as large in the East as in its native Sierra streams, it has in certain favorable localities been found even larger. It can endure warmer water than the Brook Trout and live farther downstream than that species. In streams near the sea it often lingers in brackish water.

While the Rainbow Trout is a springtime spawner on the Pacific slope, depositing its eggs from February to May, it has in its Eastern habitat adapted itself to the very different

Photograph by E. R. Sanborn

THE PIKE, A FRESH-WATER MARAUDER

The habits of the Pike are similar to those of the Muskellunge. It tries no tricks when hooked, but reels off the line as though relying on its sheer strength to get away.

climatic conditions prevailing there and now spawns in the fall and early winter, like the Brook Trout, but the eggs hatch in less time.

The vitality of the artificially fertilized eggs has made it possible to ship them to great distances in a half-incubated condition, after which the hatching process can be completed by ordinary fish-hatchery methods. In this way fertilized eggs of the Rainbow Trout have been sent to the Atlantic coast, to Europe, and even to New Zealand in refrigerated packages with but little loss.

This is the method now used in distributing not only Trouts and Salmons, but many other kinds of fishes.

Eastern anglers do not usually rate the Rainbow with the Brook Trout as a game fish, but we cannot believe that this criticism applies in its native rivers. It is, perhaps, true that it is there a better food fish. Anglers have their own ideas on such matters, and are not to be dissuaded from opinions formed in places where they have enjoyed good sport.

In the McCloud River we have taken three- and four-pound specimens, but the average is smaller. It is known to attain a weight of 10 pounds, especially when transplanted to warmer waters, or where the food supply and the large area of a lake provide conditions favoring greater growth.

It is probably not so gamy a fish in warm waters as in mountain streams. We have seen it leap repeatedly when hooked—a thing the Brook Trout seldom does.

The Rainbow is a fine sportsman's fish, taking the fly much like other Trouts, and is not a competitor of the Brook Trout in maintaining a place in the wider habitat now afforded it.

In some localities the identity of the Rainbow is confused with that of the Steelhead (*Salmo gairdneri*), also a Pacific coast fish, which has been successfully acclimatized in streams flowing into Lake Superior, Lake Michigan, and elsewhere. It has smaller scales than the Steelhead. In California the Rainbow is not inclined to seek the sea like the Steelhead, while the latter ranges far inland at spawning time, like the Salmon. A few Steelheads have been taken in the McCloud River 300 miles from salt water, and it is not unlikely that some of the Steelhead eggs were unwittingly shipped from there with eggs of the Rainbow.

With its broad, iridescent, purplish-red band along the side, the Rainbow Trout is well named.

EASTERN PICKEREL (Esox reticulatus)

(For illustration see Color Plate IX)

The Eastern Pickerel—the largest of our three species—belongs chiefly to the region east of the Alleghenies, from Maine to Florida. It reaches a length of two feet and a weight of seven or eight pounds. Two or three pounds would be near the average size, which varies, however, with the locality.

Chain Pickerel is a name much used in the North, while Jack is more common in the South. It is often confused with the Pike in waters where both are found.

Like others of the family, it leads a solitary life, except at spawning time. Pickerels cap-

tured by bait trolling in New Jersey lakes have been taken in rather shallow places, where they found shelter among water plants. Here also the Pickerel deposits its spawn. The eggs are thrown off in long masses like those of Perch and are usually seen among submerged brush and weeds. In the North it spawns in April and May; in the South it spawns earlier and grows faster.

The Pickerel stays in deeper water in winter and is then taken through holes cut in the ice.

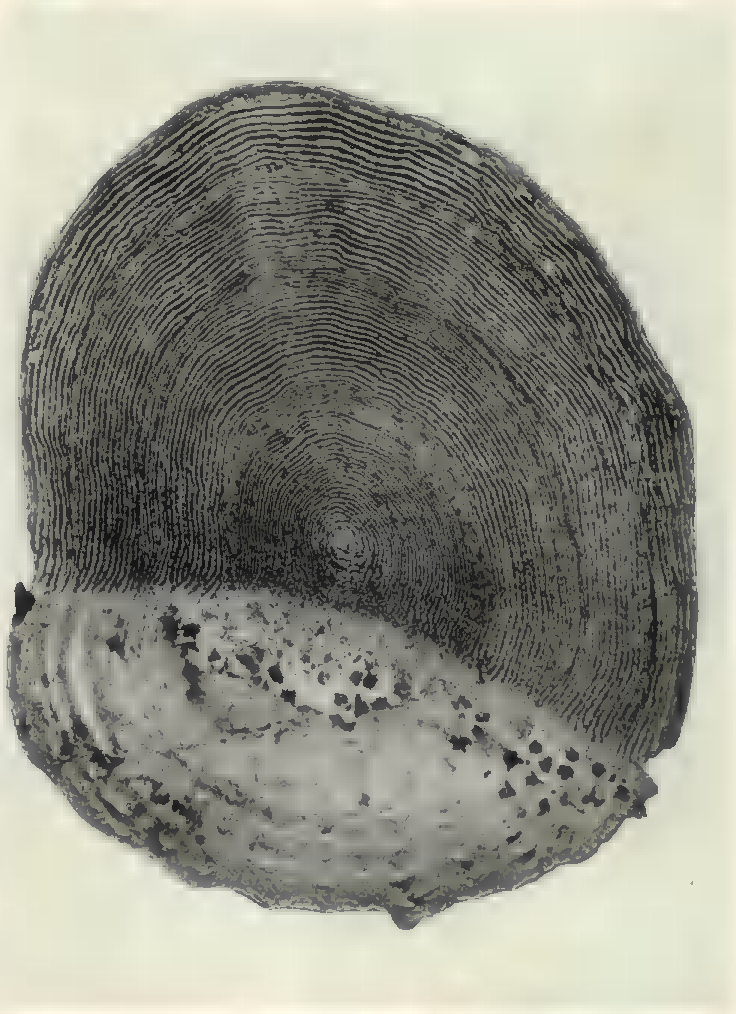
It is said that in ponds devoted to fish culture a Pickerel five years old may be a foot and a half long and weigh two pounds, but rapidity of growth depends upon the abundance of food.

The Pickerel will seize a fish half as large as itself and swallow it by degrees.

All fishes of the Pike-Pickerel family are taken by similar methods. Fishes and Frogs are good live baits and are used in trolling, casting, and skittering and artificial lures are used in the same ways.

"Skittering" is an angler's term; it is done with a long rod and a short line, by jerking the bait along the surface.

The Eastern Pickerel is probably a better game fish than either of the other Pickerels. These fishes, being rather easily caught, both in summer and winter, soon become reduced in numbers in the smaller water areas.



Photograph from U. S. Bureau of Fisheries

THE MAGNIFIED SCALE OF A DOG SALMON

This scale was taken from a mature male in its fourth year. Note the "rings," like those of the cross-section of a tree, by means of which the age of a fish can now be computed (see text, page 127).

Another species, the Banded Pickerel (*Esox americanus*), also limited to the region east of the Alleghenies, is smaller than the Eastern Pickerel, seldom exceeding a foot in length. It inhabits chiefly lowland streams and swamps, often descending streams to brackish water.

The Little Pickerel (*Esox vermiculatus*) has a shorter body and longer head than its relatives. It is a fish of quiet waters and does not exceed a foot in length. It belongs to the Ohio and Mississippi Valleys and to streams flowing into the Great Lakes.

PIKE (Esox lucius)

(*For illustration see Color Plate IX*)

The Pike reaches but half the size attained by the Muskellunge. It has much the same distribution but a greater range northward. The writer has taken it above the Arctic Circle in Alaska.

The American Pike is probably not distinct from the Pike of the Old World, but the latter is believed to be larger. Being more widely distributed and abundant than the Muskellunge, it is better known to anglers and is of more economic importance.

The Pike, like the others of its family, is one of the notoriously voracious fishes, destroying great numbers of other fishes and many water birds and small aquatic mammals. It is well equipped for the predatory life and is believed to eat about a fifth of its own weight daily. There is no doubt about its being the enemy of all fishes inhabiting the shallower waters. Only a few Pike can find subsistence in ponds and lakes of limited extent.

Photograph by E. R. Sanborn

THE CALICO BASS DERIVES ITS NAME FROM ITS MARKINGS

This fish is neither large nor noted for gameness, but it is the object of a vast amount of angling over a considerable part of the country. Market fishers take large numbers in the Mississippi Valley.

It is not a suitable fish for propagation in waters adapted to other fishes that are less piscivorous, and its cultivation should be restricted to such localities as are best adapted to it alone, and where it may subsist on fishes of the least value as game or food.

The Pike reaches a length of four feet and a weight of 40 pounds or more. There are several much-quoted records to the effect that the Pike of Europe and Siberia have been known to exceed 100 pounds in weight. Natives of the Alaska Peninsula told me repeatedly that Pike of enormous size inhabit Lake Iliamna.

It may be that the Pike attains its greatest size in far northern waters. In northern Alaska we found it abundant in all parts of the Kowak and its tributaries, especially in quiet lagoons leading off from the river. There were many lurking in shallow water among overflowed mosses, where we continually startled them in walking along shore.

Having little time for angling, we took such Pike as were needed for food by shooting them as they lay in the shallows with hardly enough water to cover them. This was early in August, when the cold Arctic streams are about as warm as they ever get, and the Pikes were probably spawning. In our Northern States they spawn soon after the ice leaves, and the eggs hatch in about three weeks.

The annual yield of Pike and Pickerel in the net fisheries of the Great Lakes exceeds 2,000,000 pounds. The identity of the Pike is often lost in the name Pickerel, with which it is associated in much of its geographic range.

An inhabitant of the shallower waters in summer, the Pike in winter seeks greater depths, doubtless following its food supply, and is taken on baited hooks set through the ice. In summer it is a solitary still hunter, lurking about the edges of weedy or brushy places. It is taken with all sorts of live and artificial baits, in trolling, casting, and skittering.

Many anglers consider Pike and Pickerel fishing a high form of sport and value them also as food-fishes, but there are others who think differently. We have enjoyed them both on the line and in the pan.

LAKE STURGEON (Acipenser rubicundus)

(For illustration see Color Plate X)

The Lake Sturgeon is the largest fish of the Great Lakes and, next to the Paddle-fish and the Giant Gar of the Mississippi River, our largest fresh-water fish. It never reaches the great size of the Sea Sturgeons ascending rivers of the Atlantic and Pacific coasts. Milner, who examined many in the early seventies, saw none longer than six feet, but found reports around the Lakes of larger Sturgeons. In 1922 a Sturgeon was taken in Lake Huron which measured seven feet three inches and weighed 225 pounds.

The history of the Sturgeon is a story of wanton waste. In 1872 Milner reported a fishing firm at Sandusky, Ohio, engaged in preparing smoked Sturgeon and caviar, which used from 10,000 to 18,000 Sturgeons a year. Before this firm began to utilize them the local catch of Sturgeons, which were always present in the nets, was destroyed as useless. This was also the practice elsewhere on the Lakes.

When the value of the fish was finally recognized, its decimation proceeded so rapidly that it soon became scarce and has been so ever since.

The difficulties encountered in the propagation of the Sturgeon by artificial methods have so far been only partially overcome. The breeding sizes available for experimental fish-culture are now so limited that extermination is feared.

In 1880 the catch of Sturgeons in the Great Lakes exceeded 7,000,000 pounds. In 1917 it had fallen to less than 100,000. In the upper Mississippi River and its tributaries the catch has fallen in proportion.

The Sea Sturgeons have also decreased at a rapid rate and fish-culture has made little progress in propagating any of them.

When we consider that the caviar alone from a single large female Atlantic Sturgeon is worth nearly $100, it is easy to realize what the passing of this fish means. Such is the rate at which we are harvesting our wild crops.

The Lake Sturgeon inhabits also the large interior lakes of British America, but statistics on the yield from those waters are not at hand. The small Shovel-nosed Sturgeon of the Mississippi River, belonging to a different genus, is of much less value commercially.

The Lake Sturgeon is inoffensive as far as other fishes are concerned, except as it may disturb their eggs, being strictly a bottom feeder and living on mollusks, crustaceans, worms, and more or less small plant life. Its mouth, devoid of teeth and placed on the under surface of the head, is suckerlike in form and can be protruded downward like those of Suckers. The heavy snout is used for stirring up the bottom.

Sturgeons have lived only two or three years in the Aquarium, but doubtless would live longer in captivity were it practicable to keep them in mud-bottomed pools and supplied with their natural foods. Unfortunately, aquatic animals confined under the conditions now practiced are compelled to subsist, especially in winter, on such foods as the markets afford.

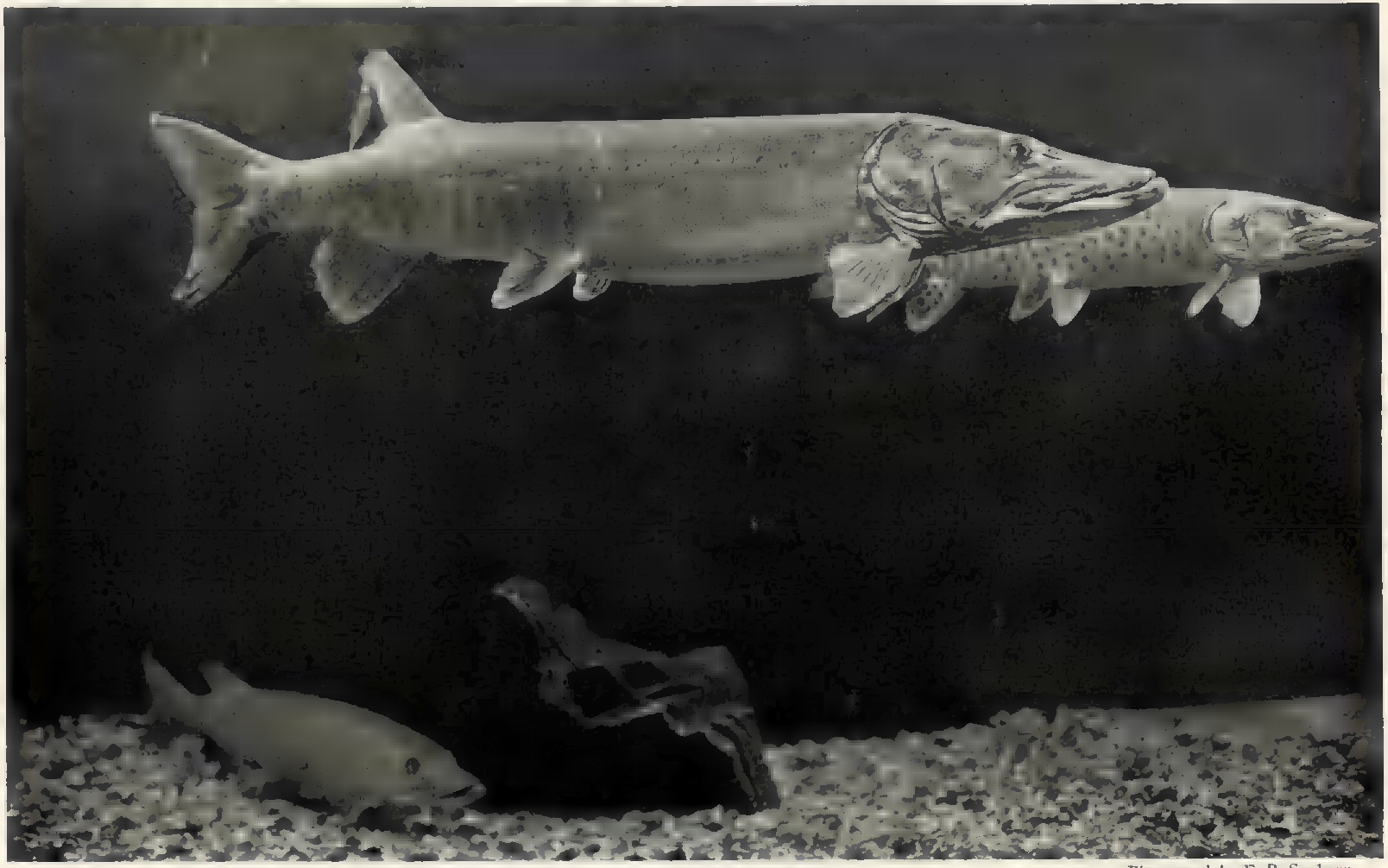
The Sturgeons are fishes of ancient lineage, the species having been more numerous in former ages, when they were more heavily armored with bony scales than are those now existing. All Sturgeons are at once distinguishable by their five longitudinal rows of heavy, bony scales.

The Sturgeon is an active fish, often leaping clear out of the water. It lives chiefly in the shallower waters along shore, where it spawns in June.

MUSKELLUNGE (Esox masquinongy)

(For illustration see Color Plate XI)

There are so many ways of spelling the Indian name of this fish that we have adopted the one apparently most in use, only after an orthographical search which revealed 24 ways of spelling it. The Muskellunge is the largest of the Pike family, being known to exceed 80 pounds in weight, while 40-pound specimens are fairly common.



Photograph by E. R. Sanborn

THE BIG AND POWERFUL MUSKELLUNGE, MOST VORACIOUS OF FRESH-WATER FISHES

This fish lies half hidden, in wait for his victim. His habit of motionless poise makes him a good subject for the camera.

It is a northern fish, inhabiting mainly the Great Lakes, Lake Champlain, Lake Chautauqua, lakes of Canada, the St. Lawrence River, and the upper Mississippi and tributaries.

It is celebrated as a game fish, having both size and strength. Unless equipped with a rod suitable for a large specimen, the angler may have to play the fish an hour before landing it.

Live bait casting and spoon trolling are the usual ways of taking the Muskellunge.

As a fish-eater the Muskellunge rivals the Barracuda of salt water, making the same fierce rushes and having a similarly large mouth set with dangerous teeth. There is, in fact, a superficial resemblance between these two widely separated fishes.

With a long, narrow body, strong dorsal and anal fins placed far back on the body, and a powerful tail, the Muskellunge is well equipped for speed. It has the look of a three-propeller craft, but the power is reserved for sudden bursts of speed, as it is not given to ranging far from its customary lair. The Muskellunge, like other fishes of the Pike family, is solitary in habit, lurking in sheltered spots, whence it darts upon its prey.

As food-fishes, neither the Muskellunge nor the other Pikes are usually rated as high as the Trouts and Basses.

The Muskellunge with which we are best acquainted is the species belonging to Lake Chautauqua and the upper Ohio River system—*Esox ohiensis*. This species has long been on exhibition in the Aquarium, where 30-pound specimens have lived four or five years at a time and would have lived longer but for accidents to the water supply. Although well fed, they have occasionally attacked their large tank mates, inflicting serious injuries. It is sometimes called Barred Muskellunge. Mr. G. A. Winchester states that the largest specimen taken in Lake Chautauqua weighed 49 pounds. Forty-pounders are taken every season, but seven pounds is about the average for that lake. A 42-pound specimen was taken in Lake Chautauqua which had a length of 52½ inches (see page 127). In this lake it is taken in summer by spoon trolling. In the autumn live baits—Suckers, Shiners, and Creek Chubs—are used.

Live-bait fishing is more effective at night and attracts larger fish. Skittering with dead Minnows is fairly successful in summer and both casting and skittering can be done over weedy areas. A good day's catch would be five or six fish. The State hatchery at Lake Chautauqua, between 1896 and 1920, turned out more than 69,000,000 Muskellunge fry.

The spawning season begins about April 20 and lasts three weeks. The Muskellunge spawns from 100,000 to 300,000 eggs, which are deposited mostly where brush, dead limbs, and logs lie in the water.

Another species of Muskellunge (*Esox immaculatus*) inhabits lakes in northern Wisconsin and Minnesota.

The members of the Pike family are readily distinguished by the scales on cheeks and gill covers. In the Muskellunge the cheek and lower half of gill cover are without scales; in the Pike the cheek is entirely scaled, the lower half of the gill cover being without scales; in the Pickerels cheek and gill cover are both fully scaled.

COMMON WHITEFISH (Coregonus clupeiformis)

(*For illustration see Color Plate XII*)

One of the most abundant and important food-fishes of the North is the Common Whitefish, which inhabits the Great Lakes and some other large lakes of the United States and British America.

There are several species of the genus, mostly of restricted range, inhabiting lakes in the Northwest as far as Alaska, but the Common Whitefish and the Menominee Whitefish (*Coregonus quadrilateralis*), also abundant in the Great Lakes, far exceed the others in commercial value.

The Common Whitefish is in the main the species on which the "Whitefish" industry is based. The catch in 1919 exceeded 6,000,000 pounds, or about half the quantity taken in 1890, so heavy is the drain made upon this food resource. The Whitefish catch along the Canadian shores of the Lakes being equal to that of the United States, we may double the above figures.

The Whitefish fortunately responds readily to artificial methods of propagation, and there are several hatcheries along the Great Lakes devoted to its increase. It is doubtless the favorite food-fish derived from inland waters. Planked Whitefish is considered as great a delicacy in the Lake regions as planked Shad around the shores of the Chesapeake.

The largest part of the catch is made in Lake Michigan and the least part in Lake Ontario. The gill net is the principal apparatus used in capture, but many are taken in pound nets and seines. The Whitefish is seldom taken with the hook, and then only with worm or insect bait.

It inhabits chiefly the deeper parts of the Lakes, moving into shallower waters early in summer, in midsummer seeking again the cooler depths. In the fall months Whitefish again come inshore to spawn, some of them entering streams for that purpose, but the migratory movements vary somewhat in the different Lakes.

Recent investigations have shown that the Common Whitefish is late in maturing, probably not spawning until after five years of age. It deposits on the average about 35,000 eggs, which hatch in about five months.

The food of the Whitefish consists of small crustaceans, small mollusks, and insect larvæ, but chiefly of various kinds of Entomostraca. Whitefish hatched in the Aquarium were carried through the critical period of infancy on a diet consisting of the larvæ of mosquitoes.

These fishes, now ten years old, have lived and grown on a diet of chopped fresh meat. Had it been possible to supply them with their natural live foods, their size would doubtless have been greater. These specimens are apparently the only Whitefishes ever brought to maturity in captivity (see page 131).

Whitefish eggs and young Whitefish are devoured in great numbers by predatory fishes.

The largest Whitefishes seldom reach a weight of 20 pounds, and such are rare, the average as brought to market being only three or four pounds. Females are larger than males.

The Whitefishes as a group are considered the most important fresh-water fishes in the world, and there can be no doubt of the fact that they are undergoing progressive depletion.

FRESH-WATER DRUM (Aplodinotus grunniens)

(For illustration see Color Plate XIII)

The Fresh-water Drum is a large fish belonging chiefly to the Great Lakes and the Mississippi Valley. It reaches a length of three or four feet and a weight of 40 or 50 pounds. It is a food-fish, wherever taken, and more popular in the South than in the North.

In 1899 the catch of Drum in the Mississippi and its tributaries exceeded 3,000,000 pounds; in the Great Lakes in 1917 the catch amounted to nearly as much.

The Drum is a bottom fish, living mostly in muddy waters, feeding on Snails, Mussels, and Crayfish, for which its heavy paved teeth are well adapted, and it is not given to the eating of other fishes.

It is not a popular angler's fish, but is often taken with Crayfish bait, and the young are better eating than the adults. The net fisheries take the bulk of those marketed. In the North it is often called Sheepshead, while in Louisiana it is best known as Gaspergou.

The Fresh-water Drum makes drumming or grunting sounds not unlike those made by the Sea Drum, and this is the meaning of its specific name, *grunniens*.

The noises made by Drums, Croakers, and other sound-producing fishes are accomplished by muscles drawn across the air bladder, by the grinding of their blunt teeth, and in other ways, fishes having no real vocal organs.

The ivorylike ear bones, or otoliths, of this fish are popularly known as "lucky-stones," a fancy originating in a marking resembling the letter L.

The Fresh-water Drum has proved to be a hardy fish in the tanks of aquariums, where it gets little of its natural food.

YELLOW PERCH (Perca flavescens)

(For illustration see Color Plate XIV)

The Yellow Perch is one of our best-known fresh-water fishes, being abundant throughout the Northern and Eastern States, especially in lakes and ponds. On the Atlantic slope it extends somewhat farther south than in the Mississippi Valley, where it is confined to States bordering on the Great Lakes.

In the North it extends from Nova Scotia and Quebec westward to Minnesota.

The market catch by nets in the Great Lakes sometimes exceeds 9,000,000 pounds a year, while anglers in towns along the Lakes take great numbers and find sport in doing so. The catch by anglers in smaller lakes and ponds everywhere is very large.

The Yellow Perch comes as near to being everybody's fish as any other and but little art is necessary in taking it. It is ready to sample all the baits of the amateur and even responds to baits let down through the ice in winter, when many other fishes are sluggish. The expert takes it both with artificial fly and trolling spoon.

As a food-fish, there is none of better flavor among the commoner kinds. It is easily identified by its broad cross-bands of black, as no other native fresh-water fish wears the same combination of black and gold.

Like other fishes of extended range, it has several names, viz., Yellow Perch, Ringed Perch, Raccoon Perch, Red Perch or Striped Perch, according to locality. Its length may be as much as 14 inches and its weight about three pounds, but such sizes are unusual.

The Yellow Perch is one of the easiest fishes to introduce into new waters. The eggs are extruded in zigzag-shaped bands, which, by the rapid absorption of water, became large masses, seen along the shores in shallow water. Employees of the Aquarium gather such masses in the ponds of Long Island in March and April, which are hatched indoors as a springtime fish-cultural exhibit, the young fry being placed in local streams and ponds.

The egg masses may be found at any time after the ice disappears, according to the latitude.

Yellow Perch have been kept 11 years in captivity on no other food than fish purchased in the markets, although its natural live foods include practically all the smaller forms of fresh-water life.

The Yellow Perch runs in schools and frequents moderate depths. It is a difficult fish to dress because the scales cling so tightly to the flesh.

PIKE-PERCH (Stizostedion vitreum) and SAUGER (Stizostedion canadense)

(For illustration see Color Plate XV)

The Pike-perch, perhaps better known as Wall-eyed Pike, ranks next to the Whitefishes and the Lake Trout in quality and commercial importance among the fishes of the Great Lakes, where the market catch in 1917 amounted to 4,500,000 pounds.

While the average weight of this fish in the Great Lakes is less than 10 pounds, it occasionally reaches a weight of 25 pounds and a length of three feet. In other northern waters the average is less than five pounds. The young are usually known as Blue Pike.

Although the Pike-perch inhabits clear waters everywhere in its range, it is a fish of the lakes rather than the rivers. It is found from Lake Champlain westward to Minnesota, in the interior lakes of New York, and in the Mississippi Valley, but through fish-culture operations its habitat has been greatly extended. Its range also extends well into British America.

Perhaps no fish lends itself better to artificial propagation; more than 300,000,000 were liberated from Federal hatcheries on the Great Lakes in 1921. A few millions are hatched an-

nually in the Aquarium, where the process of incubation in glass jars always attracts the attention of visitors. As handled in the fish hatcheries, a large specimen may yield 300,000 eggs.

The Pike-perch belongs to the family of Perches, although its form is suggestive of the Pikes.

While it is regarded in the markets as one of the best of our food-fishes and great numbers are taken in the net fisheries, it is highly appreciated as a game fish. The angler does not find it a difficult fish to catch and a large one will resist like a good-sized Pickerel.

The Sauger, also called Sand Pike, is a little brother to the Pike-perch, resembling it in general appearance, but in size does not average more than a quarter of its weight. It has a smaller eye, a more pointed head, and a lighter coloration. It has much the same geographic distribution.

The Sauger is a good food and game fish, taken in trolling and casting both with bait and lure. In some localities great numbers are taken with seines.

COMMON EEL (Anguilla rostrata)

(For illustration see Color Plate XVI)

The annual catch of Eels for market along the Atlantic coast from Maine to Florida exceeds 3,000,000 pounds and is worth $250,000.

Recently three barges, each more than 100 feet long and 12 feet wide, arrived at New York from Quebec with 165,000 pounds of live Eels. They were towed by way of the St. Lawrence River, Lake Champlain, and Hudson River and were 13 days in transit. The barges are virtually well-boats, or live cars, the bottoms consisting of heavy slats, with narrow spaces between to provide abundant circulation of water.

The catch is made when Eels are working toward salt water and is heaviest during the dark of the moon. The season is from July to October, inclusive.

Large as is the catch of Eels in America, it is vastly more so in Europe.

Science knows more to-day about the Eel than it did some years ago, and the missing chapters in the Eel's life history have been supplied through modern deep-sea investigations rather than in the study of fresh or coastal waters, where Eels are more in evidence.

Unlike Salmon, Shad, and other fishes which enter fresh waters to spawn, the Eel descends streams at maturity to spawn far at sea. The young Eels—three inches or so in length, called Elvers—that enter fresh waters in the spring in large numbers, and are continually working upstream, have always been known, but the stages of growth between the egg and the Elver were not.

These stages in which the baby Eel does not exceed three inches in length are of comparatively recent discovery. We here find it a thin, flattened creature, so transparent that ordinary print may be clearly read through its body. When first described in this stage it was called *Leptocephalus* and was not known to be the Common Eel.

These transparent larval Eels found at sea in the winter months grow rapidly, and by the end of the year are more than two inches long, when they begin to transform. By the time they are a year old they begin to appear in fresh-water streams as Elvers or young Eels about three inches long.

Investigations by the Danish vessel *Dana* in 1920 and 1921 have shown that the early larval stages of both the American and the European Eel are found only in the western Atlantic, at depths of 600 to 900 feet. The former spawns to the south and southwest of the Bermuda Islands, the latter to the south and southeast.

While the American Eel begins to enter fresh water at the age of a year, the European species remains three years in the larval stages before it appears as the Elver in European streams. The latter, like the American Eel, goes far inland, even passing within the borders of Switzerland.

Females with ripe eggs are unknown, the millions of undeveloped eggs carried by each female not developing while the Eels linger in fresh or coastal waters.

The Eels found far inland are always females and remain in fresh water for several years. It is only when tending toward reproductive maturity that they seek the sea. Male Eels remain in tidal waters and are smaller and less in evidence. Like females, they do not reach breeding maturity until they have passed to sea.

The great bulk of the Eel catch everywhere consists of females. It is said that all the Eels captured in the great Quebec fishery are females moving downstream.

The Eel catch in the St. Lawrence River is derived from Eels belonging to that river and its tributaries, including Lake Ontario. The Lake Ontario catch of Eels in 1899 exceeded 123,000 pounds. The annual yield of all the other Great Lakes combined seldom exceeds 2,000 pounds, the Falls of Niagara constituting an impassable barrier to all kinds of fishes.

Enormous numbers of young Eels gather below Niagara in spring and summer, but there is no evidence that they ever pass farther by that route.

The Eels of the upper Lakes may pass up by way of the Erie and Welland canals. It may be that limited numbers of Eels in the Mississippi River find means of passing into the Great Lakes. Whether Eels inhabited these lakes before the construction of canals, the writer is not informed. The fishery statistics at hand contain no records of Eels in Lake Superior.

Eels enter all American streams from the St. Lawrence River to the Gulf of Mexico. It is only the young Eels that move upstream. Adults move downstream and do not return. Both males and females die at sea after the first and only breeding season in their lives. The Eel is very prolific, each female producing from 5,000,000 to 10,000,000 eggs.

Eels are taken in other ways than with nets. "Bobbing for Eels" is done with worms strung on thread, which looped in a small bunch make a bait very attractive to Eels. They are also taken in small wire traps called eelpots, by eel-spears, and are even taken by digging and spearing in the mud, where they bury themselves in winter.

AMONG THE SKYSCRAPERS OF A HERON VILLAGE

A nearly-grown young bird in the foreground left the nest when the camera man sat down in it. This colony of Great Blue Herons is in a big sycamore grove at the southern end of San Francisco Bay.

HUNTING BIRDS WITH A CAMERA

A Record of Twenty Years of Adventure in Obtaining Photographs of Feathered Wild Life in America

By William L. Finley

Of the National Association of Audubon Societies

With Illustrations from Photographs by H. T. Bohlman, Irene Finley, and the Author

AS FAR back as I can remember, I can see the Black-headed Grosbeak that took his meal of elderberries in the tree just outside the east window. I recall the Goldfinches flocking in the autumn fields and I hear the evening calls of the White-crowns gathering in the rosebrier to spend the night. These were all friends of my childhood days. The lure of the wild birds developed into a hobby.

Later the opportunities opened for me to hunt out the haunts of rarer birds and make friends with them. Finally, I have made business out of pleasure by lying in wait with camera and notebook.

Behind the years of hunting lies an eagerness for the chase that has been fully satisfied in hunting and shooting with the camera. Outwitting has often come in outwaiting a shy subject. Some call it patience, but it is a lasting joy that has come with the quiet chances to study at bird homes and learn of the real character and individuality in these wild children of nature.

THE PAINTER'S ADVANTAGE OVER THE PHOTOGRAPHER

Years ago, in reading about Audubon and looking at the pictures in his big portfolios, Bohlman and I developed an ambition to show some of the things with the camera which this great naturalist had shown with the brush.

Our object was to secure a series of photographs of American birds that were both artistic in value and which showed the home life, traits, and habits of individual species. To achieve this aim, the search was made for typical nests of artistic setting, and when these were found, visits were made from time to time to get different stages of growth of the young birds and to make a photographic life history of the species.

We soon discovered that the skilled painter has an advantage over the photographer in many ways. The art in a bird photograph is so greatly limited by the working possibilities of the camera.

The painter may place his Heron on one side of the river or the other, plant his trees just where they produce the best effect, make the water ripple or reflect, flow east or flow west.

When the camera hunter tries for these effects, he has to search high and low for foreground or background. He has to move to suit the light. Even if he selects a good position, he never knows just when his bird subjects are willing to pose. He may try for days and weeks and not succeed in getting a combination that will make a picture.

A good bird photograph is a reflected image of facts. The reality of things, the truth, is the appeal which the photograph makes. We cannot set photography over against art. A photograph has to be studied for its own sake. It may be compared with other photographs, but not with creative work of pen or brush.

In considering the photograph from an artistic standpoint, we have to take into account the relation between the camera, which is a mechanical means of expression, and the ideas expressed in the picture. Because of the difference in the means of expression, we cannot compare a picture made with a camera to a painting made with a brush.

In wild-life photography one generally has to take what he can get. Yet this is not always so. One may often obtain photographs of artistic value by combining a technical knowledge of the camera with a sympathetic study of nature. He

THE CAMERA HUNTERS CORNERING A DUCKLING IN THE MARSH

A baby Duck is quick at diving and darting, and it is hard to catch him still a moment in order to get his picture. He begins to hunt his own living the day after he is out of the egg.

may sometimes select his position and his subjects; if he has the patience to wait hours and maybe days, he can get the make-up of his picture.

This we did in the case of the Caspian Terns nesting on a tule island in Lower Klamath Lake, Oregon. We set our camera, carefully concealed in a blind, to get a small bunch of tules in the foreground and the lake in the background. With this combination for a picture we exposed plate after plate at the Terns flying past. Out of 20 exposures one was successful.

In southern California Mrs. Finley and I tried for days to get a combination picture of Gull, clouds and waves. Both Gull and waves were moving so rapidly that the highest speed was necessary. The distance between the two objects made it impossible to get both in focus at once. With the bird near enough at hand to show clearly, one had to forfeit the clearness in the balance of the picture. Whenever the waves were breaking just right, it was almost impossible to catch a Gull in the right position and *vice versa*.

THE GREAT BLUE HERON IS AN ARTISTIC POSER

Some birds make up much better in photographs than others. The attitude of the Great Blue Heron at rest is in itself artistic. While photographing in a colony of these birds in the San Francisco Bay region, we hunted for several days to select a position that would have an artistic make-up. The best we could find was the outermost branches of a tall sycamore.

The only viewpoint for the camera was from the top of an adjoining tree. At this place we had to erect a small stand and tie the camera in position. The distance was too far for the regular lens, but with the telephoto attachment a good picture was obtained after the old Heron returned from fishing and perched on a dead limb at the side of her nest (see page 173).

The first trips of any consequence that Bohlman and I took to study bird life were in 1897 and 1898. During the summers of these years we made two long canoe trips to the headwaters of the Willamette River and into the mountains. In the summer of 1899 we cruised Lewis River in Washington as far as Tum Tum Canyon. During this trip we were capsized in one of the swifter rapids and lost the camera and part of our equipment.

STUDYING SEA BIRDS FROM ROCKY CLIFFS

Our first intensive work in making photographic studies of wild birds was one summer, when we were landed on some of the rocks off the Oregon coast by sea-lion hunters. At this time we had our first glimpse of the great colonies of birds that lived on the sea cliffs.

We decided to return at the first opportunity and make a careful photographic study of the sea birds. This could not be done in a day or several hurried trips, so we decided to hazard a camp on the ledges and stay until we could complete our work.

Two years later we pitched our four-by-seven tent on the beach opposite Three Arch Rocks. Although it was the latter part of June, the sea winds were cold and the rain continuous. Occasionally the sun would break from the clouds for a day and our hopes would rise as the size of the breakers diminished, but this would be followed by a sou'wester that brought a steady drizzling rain and lashed the white caps as high as ever. We were wet half the time, but did not catch cold. We soon reached a sort of amphibian state, where a condition of water soak was normal.

Three Arch Rocks are about a mile offshore. These great stacks of basalt, so named because each has a huge arch through the base, are the largest islands off the Oregon shore. They lie two and a half or three miles north of the narrow entrance to Netarts Bay and about six miles south of the entrance to Tillamook Bay.

We had but one way of reaching the rocks, and that was by means of a 14-foot dory. We tried twice to go out over the bar, but we were not able to discover a break in the oncoming line of combers. The treacherous current nearly wrecked us on the outer spit. We decided the only way to get out from the ocean beach was to land our dory in the surf at a point opposite the big rocks.

For 16 days we lay in camp while the waves throbbed incessantly. We often lay awake at night, hearing the rain beat on the canvas and listening to the wind,

trying to imagine the growl of the surf was growing fainter.

Every morning we crawled out in the gray light to see if we could detect a gap in the line of breakers. We lay in the sand by the hour with our field glasses, looking at the bird world offshore. The longer we looked, the more alluring the rocks became.

One morning, when we had grown impatient, we tried to drive our boat through the lowest place in the surf barrier. We waded in with our little dory until she floated. Watching our chance, we jumped to the oars. The nose of the boat plowed through the foam of the first and second breakers, but they tossed her like a toothpick. She shot at the third like a hunter at a fence, but failed to reach the top before it combed. Crash! came half a ton of green foaming water down my back.

We swerved a little to the right and another monster rose like magic. Several tons of the next wave piled over us, and the third tossed us shoreward empty as a cracker box. We had taken the precaution of wrapping our camera equipment in water-tight bags and tying them in the boat. We dried out the rest of the day and went at it again the following morning, with about the same success. The next day the surf dropped lower and we reached the smooth water beyond.

A BABEL OF WILD-LIFE VOICES

As we pulled near the rocks the air-laden guano smell struck our nostrils. The babel of distant sounds was broken by the scream of a near-by Gull or the roar of a sea lion. As we approached the lowlying rocks, the huge hulks of sea lions were stretched like logs thrown up by the tide. The ranks grew thinner as they receded from the water's edge, till the topmost ledges were held by three lumbering bulls. They were all alert. They dragged themselves along the shelves on their elbows as a person would whose hands and feet are tied.

The bellowing grew louder and louder, until one would have thought the foghorns of a fleet of battleships had suddenly broken loose.

Mingled with the roaring of the bulls were the bleating of a hundred calves and the cries of thousands of sea fowl that scurried overhead like swarms around an arc lamp in May-fly time.

We could not talk above the din. When we got nearer, many of the lions wabbled to the edge of the ledges and rolled off in the water. Those nearer the top came down the slope in a series of jumps that ended in a splash. The last old bull on the top left slowly and defiantly, like a captain reluctant to leave his sinking ship. Two mothers and a crowd of babies stayed.

Far up under the eaves of those great stacks of basalt we could see the California Murres whirling and flashing in circles. Thousands sat in long white waist-coated lines on every available shelf, as if on dress parade. Others splattered over the water and dived about our boat.

Squadrons of pug-nosed Puffins with short wings and roll-shaped bodies buzzed about the crags like bumblebees. White-winged Gulls, curious and cackling, followed our wake. Ungainly Cormorants flapped solemnly away, while others returned strung out in Indian file. Far up the sides, and penciled against the blue sky, we could see their black regiments standing at rigid attention beside their nests and eggs.

We decided to land on the south side, where the rock shelved down to tide level. A steady ground swell of 10 or 12 feet would not let the boat touch the rock. As the wave receded, we backed in and one of us landed in a flying leap, while the other pulled away to keep from being dashed against the jagged rock by the next breaker.

Provisions had to be tossed ashore. Some of our bulkier belongings barely escaped a watery grave. The hardest task was in ledging the boat. We swung her well in on the crest of a big wave, jumped, and held her as the water receded; then, with block and tackle, we worked her up to a 12-foot table away from the lash of the waves.

Looking for a camping spot on the rough side of the cliff was a good deal like hunting for a lodging on a winding staircase. There was but one spot wide enough to stretch out upon, about 40 feet up from the landing place. We awoke the next morning feeling as if we had spent the night on the top of a broken picket fence.

THE AUTHOR'S FRIENDS, A FAMILY OF DESERT SPARROWS

Little Johnnie, in the rear, was afraid his turn would never come: but he got the next mouthful. While these young birds looked alike, the mother knew one from the other, especially at meal time.

A GOOD WING SHOT OF A FEMALE PINTAIL DUCK

Shooting with a shutter is many times more difficult than shooting with a gun. The camera was hidden in a blind and the photographers waited all day before getting this picture.

A ROAD RUNNER, OR COCK OF THE DESERT

A typical bird of the cactus country of the Southwest bringing in a whip-tailed lizard to her young in a cholla cactus. Her larder contained four kinds of lizards.

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YOUNG GOLDEN EAGLES READY TO BREAK HOME TIES

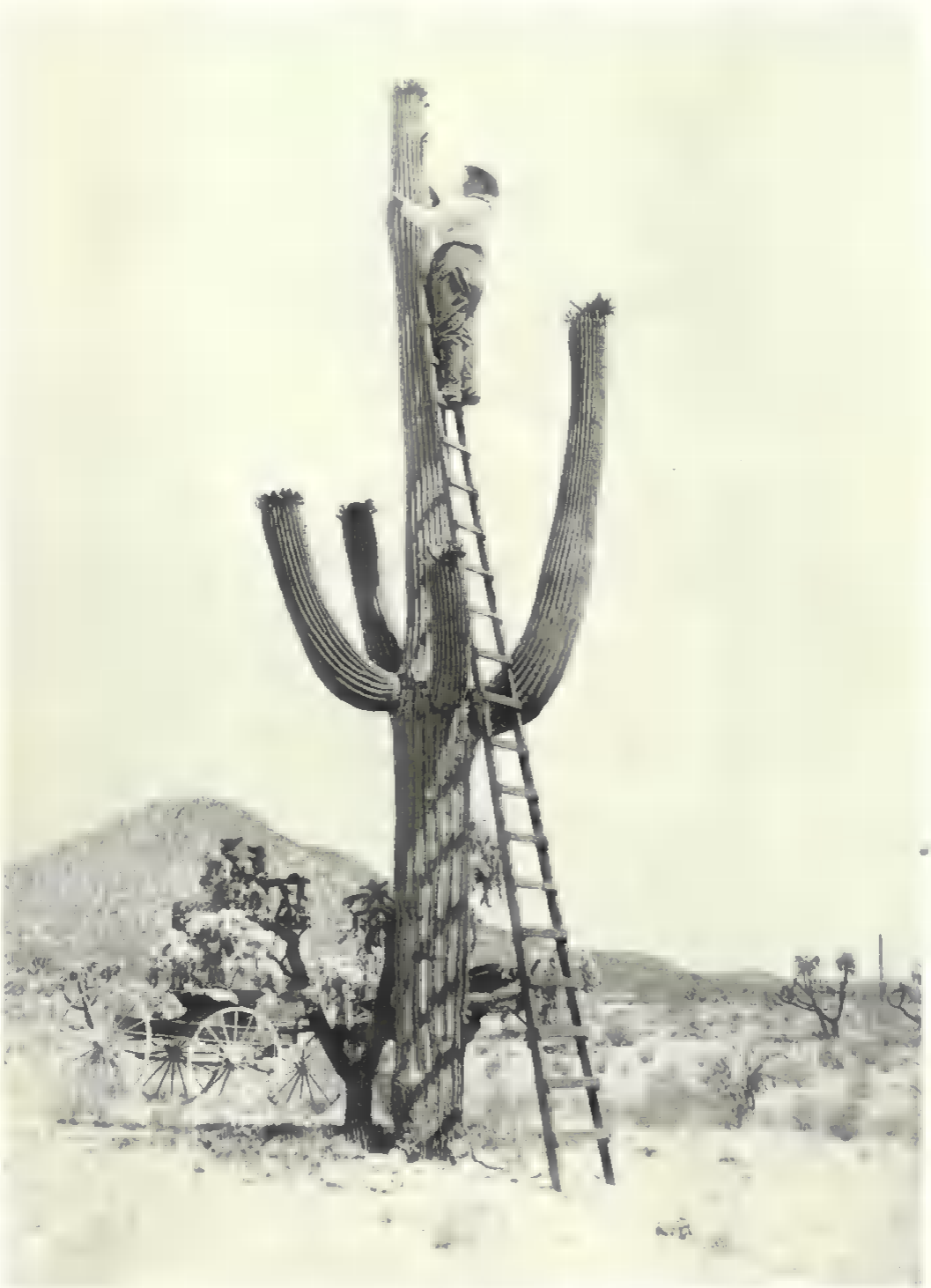
There are two species of Eagles in the United States—the Golden Eagle, nearly exterminated east of the Mississippi, and the Bald Eagle, our national bird. Alaska is trying hard to reduce the number of the latter. Her bounty law has caused the slaughter of about 12,000 Eagles to date. The salmon canners claim that the Bald Eagles catch many fish and are destructive to fur-bearing animals and reindeer fawns.

"THE BENEDICTION"

A parent bird is seen alighting in a colony of half-grown young Pelicans crowded together like children in a day nursery. As a rule, there are two young in each family.

A DANGEROUS CLIMB AFTER SEA BIRDS

California Murres live on the inaccessible ledges of the sea cliffs. Through the efforts of the National Association of Audubon Societies, these rocks off the Oregon coast were set aside as a Federal reservation for sea fowl by President Roosevelt in 1907.



VISITING THE HOME OF AN ELF OWL IN ARIZONA

The tiniest of all Owls, about the size of an English Sparrow, generally takes a deserted Woodpecker's hole in the top of a giant cactus. No one could climb such a tree, but a 25-foot ladder reached the nest-hole.

A WEDGE OF WHITE PELICANS

No ship will ever sail the skies with the grace and beauty of a White Pelican. While ungainly in appearance, a flock of these birds winding slowly among the clouds is a sublime sight. The wings, partly black in color, make a showy contrast with the white of the body.

GREAT BLUE HERON ON GUARD BY HIS NEST

This bird is sometimes erroneously called "Crane." He has long legs for wading after fish and frogs, is about four feet high and, if he were subject to human ailments, would have about 12 inches of sore throat.

A LONG CLIMB TO A RED-TAILED HAWK'S NEST

A Red-tail likes to get the highest place for his aerie, so he can have a good outlook. This one, in the central part of California, was 80 feet from the ground in a eucalyptus tree.

PICTURING THE AERIE OF A GOLDEN EAGLE IN CENTRAL CALIFORNIA

The big birds had carried a cartload of limbs and sticks and built a platform nest, five feet across, strong enough to support a man.

A YOUNG AVOCET AT HOME IN THE MARSH

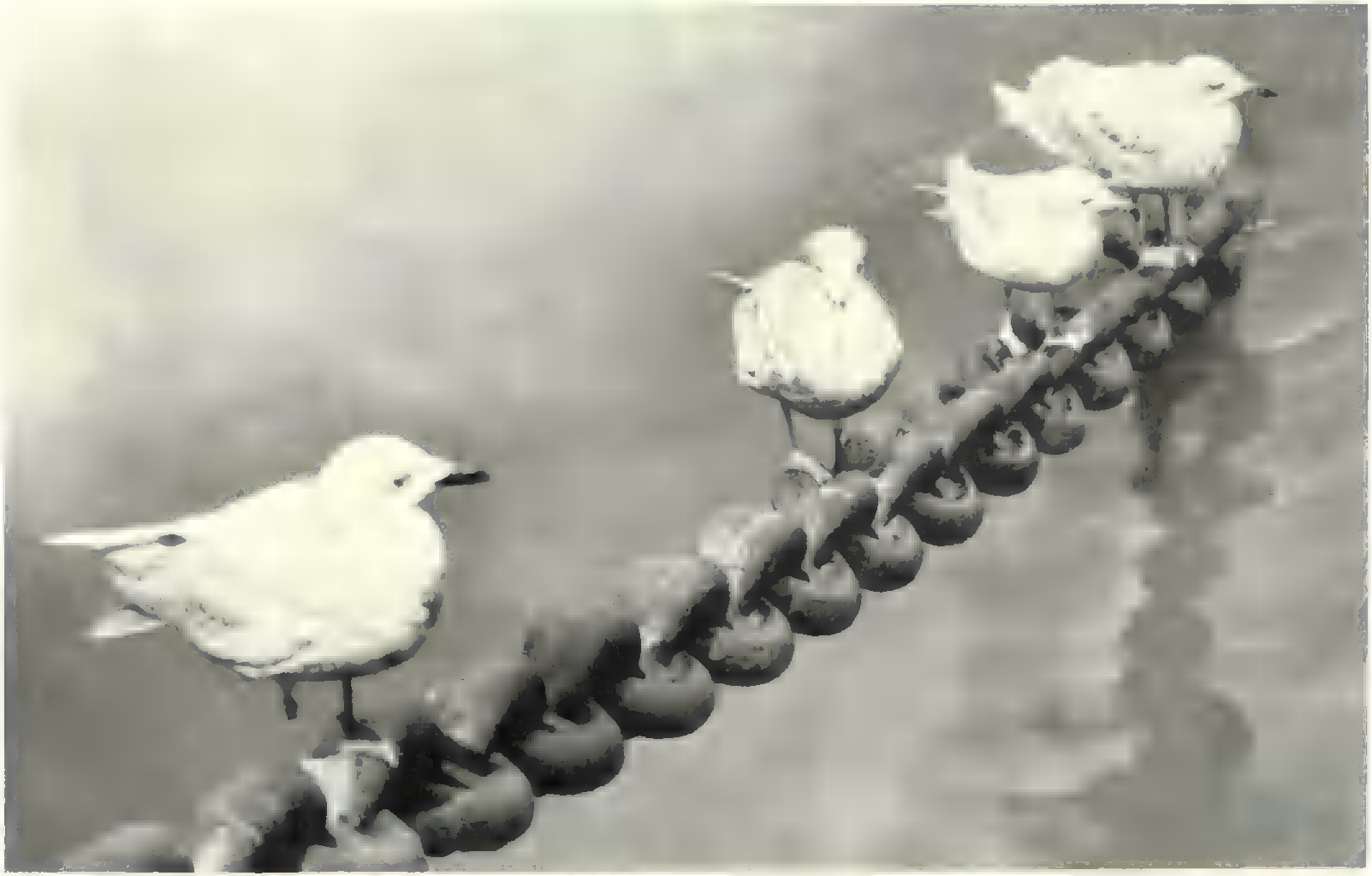
The Avocet is a resident of the great marsh areas of the West. His skirts are cut short for wading and he moves along in the water, swinging his bill from side to side, hunting for water insects.

CALIFORNIA CONDOR ALIGHTING ON THE MOUNTAIN SIDE

The Condor is the largest bird that flies and also one of the rarest. He weighs from 20 to 25 pounds and has a wing spread of 9 or 10 feet. When under sail, a bird of this size always has difficulty in making a safe landing.

A FAMILY OF HALF-GROWN BURROWING OWLS

These Owls are associated with prairie dogs and ground squirrels. The nest is always several feet under ground in the deserted home of one of these animals. It was formerly reported that birds and rodents lived together in the same burrow, but this is not true.



GULLS ON AN ANCHOR CHAIN

These birds are at home along the waterfronts of our seacoast cities, where they live during the fall and winter, picking up waste scraps of food. In summer they nest in colonies on the islands of inland lakes or on the sea rocks off the coast.

A COVETED PLACE ON THE BOWSPRIT

Gulls live about a ship as a robin does in a garden. They will coast along at the stern of a steamer for days to get a meal of choice "seconds" thrown out by the cook. There seem to be reliable records of Gulls following the same vessel from the Irish coast to New York, a distance of 2,560 miles.

On the next two flats just above ours were two large "chicken yards" of Murres. The clamor of these quarreling birds lasted long into the night and began with renewed vigor at daylight.

Although everything was open in camp, the ventilation was vile. The whole island was rancid, in spite of the airing it got from every wind of heaven.

After breakfast we started out, Robinson Crusoe-like, to explore the rock. This rose in abrupt cliffs from the sea, but the south side, upon which we were camped, was well ledged.

By climbing from shelf to shelf and zigzagging back and forth, we found a way to the top. One shelf had to be scaled with a rope. At another a projecting knob enabled one to look straight over the drop for 150 feet, and around this we had to edge our way. A little above was a portion of the cliff that was crumbly and broken. Here we climbed from the nest of one Cormorant to another and clambered on up to the pinnacle of the rock, where we could get an idea of the size of the island.

GULL SCRATCHES HIS EAR WHILE ON THE WING

One of the prettiest sights about the rock was the Gulls, which filled the air like so many feathery snowflakes. Their immaculate white bodies and soft gray wings tipped with black were delightful to see.

I liked to watch them because they were masters of the air. There was a constant adjustment of wings to meet every air current that struck the rock; but in a steady breeze the movement was too slight to see and they hung motionless, as if in a painted sky. They tacked straight in the teeth of the wind. I saw one retain perfect poise and at the same time reach forward with his foot and scratch his ear.

A Gull in his own country will steal and murder like a pirate. If a Murre or Cormorant left its home without a guard, these saintly looking scalawags swooped down to eat the eggs and young.

The Murre has a large, tough-shelled egg which the Gull's bill cannot penetrate. But these robbers know enough to pick it up, fly out, and drop it on the rock below or nose it along until it drops to the shelf below, when they can devour the contents.

Oftentimes I have seen a Gull pick up a young Murre or Cormorant not long out of the egg and swallow the youngster alive. The downward course of the young bird was marked by a bulge in the Gull's neck.

I have often seen a Western Gull act in a way that speaks well for his sagacity. I have watched him open clams and mussels at the seashore. His bill is unfitted for crushing the hard shell, but he will take a clam, rise to a height of 30 feet, and drop it to the hard sand and gravel below. If it doesn't break, he will continue the performance. I saw one bird do this 15 times before he was successful.

PETRELS BUILD ANNEXES TO PUFFINS' NESTS

The roof of the island rock is covered from one to three feet deep with a loose coating of earth. It is fertilized with the guano of countless generations of sea fowl. From this sprouts a luxuriant growth of chickweed, clover, and other grasses.

The whole surface is so perforated with the burrows of Tufted Puffins, Beal Petrels and Gray Fork-tailed Petrels that one can scarcely walk without sinking into the nests.

The Puffins dig in from two to three feet, and a burrow will often have two or three openings.

A Petrel sometimes uses the door of a Puffin's nest as an entrance and digs himself a kind of a side bedroom off the main corridor. It is not unusual to find one or two Puffins along the main hallway and a couple of Petrels lodged in the attic.

A near front view of a Tufted Puffin is more like a modern battleship than a member of the feathered tribe. It has a huge red and yellow bill and long yellow curls. According to the Lamarckian theory, the bird has been doing nothing since creation but sit around on the rocks and bite open clams and mussels (p. 195).

PUFFIN PROVES A VICIOUS BITER

My first experience with an old Puffin prejudiced me. I wanted a Puffin's egg, so I dropped on the ground, thrust in my arm to take one, and was somewhat taken in myself. I thought at first I had run my hand into a beaver trap. I couldn't get loose until I dug the beast out and

A WHITE PELICAN LEAVING A COLONY

This species is larger than the Brown Pelican, having a wing spread of eight or nine feet and weighing 15 or 16 pounds. The bird rises with difficulty, but, once under way, sails with surprising ease and grace (see page 172).

pried her jaws open. She cut through the flesh to the bone. The odds are always against your getting an egg if there is an old sitting Puffin hen in the hole.

We might have lived on the rock for a month and climbed over it every day and not known a Petrel was there, if we had not found their hiding places. They are nocturnal in their nesting habits and are never seen about the rocks in the daytime. By digging in the soft earth, it was not difficult to unearth Petrels and their nests. One of the parents stayed in the burrow.

The Petrel nestling is fed during the day by one of the parents thrusting its beak down the mouth of the young bird and injecting a yellowish fluid. The old birds become expert at this. If you take one out of its burrow, he will immediately "play Jonah" in your direction with surprising power of projection. A dose of rancid fish oil shot up your sleeve is not pleasing!

One evening we made the dangerous trip to the top of the rock and hid on the north slope. At the last gleam of daylight the Petrels, returning from the open sea, swept in upon the island like a swarm of bats. Those in the burrows came chittering out to meet them.

The ground beneath seemed full of squeakings and the air with soft twitterings and whistlings. We felt the breath of swift wings, but not a bird could be seen, not even a shadow. Here were acres of nesting holes hidden down in the tall grass and in the darkness of the night; yet each bird had some inexplainable way of finding his own front door in this hidden city.

The novelty of our situation had a great deal to do with relieving the hardships and dangers we had to undergo in living for five days among the sea birds on the vertical side of the rock island.

We had two 10-gallon casks of fresh water. We could have lived here as long as the water lasted, for it was easy enough to catch fish and we had an unlimited number of eggs. We had various kinds of omelet, according to the species of birds on the island. Fresh Murre eggs were excellent for cooking purposes, and Cormorant eggs, hard boiled for luncheon,

THE PELICAN YAWN

The Pelican has an elastic bag or pouch that hangs from the lower part of the bill. This is used as a dip net. The bird swims along, up-ends, and dives for a fish. It was formerly thought that this pouch served to convey live fish, swimming in water, to the little Pelicans at home; but it would be impossible for a Pelican to fly with his burden so out of trim.

A YOUNG PELICAN GETTING HIS DINNER

A mother Pelican regurgitates a fishy soup and the baby helps himself out of this family dish. When he is half grown, the mother opens her mouth, and his whole head and neck disappear while he hunts for his dinner in the internal regions.

A FEAT IN TREE-TOP PHOTOGRAPHY

At the aerie of a Golden Eagle when the nestlings were nearly grown. One camera man had to climb over the nest to the end of the limb beyond. This photograph was not taken by a third person, but a second camera was tied in the top of the adjoining tree and the shutter released by a long thread.

are better than chicken eggs. The white of the egg is not white at all but a transparent blue of gelatin consistency and is very edible.

NO POETRY IN A SEA-BIRD RETREAT

There is not much poetry on the island. A nature lover who might fall into ecstasies over a song bird in the woods would receive a severe jolt the minute he came near an ear-splitting Murre colony or got the faintest whiff of the atmosphere.

We could not climb along the ledges an hour without risking our lives in a dozen places. While camped on the rock, we wore rubber-soled shoes, so we could hang or cling to the surface with some degree of safety. Even with these, we often found our toenails instinctively trying to drive through the soles of our shoes to get a better hold.

Up and down the ridge of the rock was a large colony of Brandt Cormorants, birds commonly called Shags. Their nests were scattered a few feet apart for over 100 yards. The nests were built up in funeral-pyre fashion by the débris of past generations, grass and seaweeds, fish bones, and the disgorged remains of banquets. In every nest were four or five eggs of skim-milk bluish tint, over which it looked as if an amateur whitewasher had smeared a chalky surface.

When I first looked at a motley crowd of half-grown Cormorants, I thought Nature had surely done her best to make something ugly and ridiculous. They stand around with their mouths open and pant like dogs after the chase on a hot day. Their throats are limp and flabby and shake at every breath. Their bodies are propped up by a pair of legs with a spread of toes as large as a medium-sized pancake.

The youngsters have no very clear notion of what feet are for, at least on land. If you go near, they go hobbling off like boys in a sack race.

It is not uncommon for young birds to fall over the ledges of the cliffs, where the population is so crowded. Late one afternoon, while preparing our usual meal at our camp, which was partly protected from above by the overhanging rock, we were startled by an avalanche of loose gravel. We jumped for cover as a half-grown Cormorant came flopping down and landed with a thud in a heap at our feet. He came from one of the nests about 75 feet above.

Such a fall would have broken every bone in the body of an ordinary creature. The newcomer got up a little dazed, twisted his neck in a few grotesque curves, as if just waking up; then he climbed over our pots and pans to the end of a board which served as our dining table, crept up close to our fire, drew in his long neck, and went sound asleep.

The California Murre is by far the commonest bird on the rocks. It crowds together in immense colonies. The bird lays a single egg in the open, with no sign of a nest, not even a bit of grass or a stick to keep it from rolling. Its peculiar shape helps to keep it in place, even on the bare, sloping rock, and if it is accidentally started down grade by the movement of a bird, it does not roll straight, but swings around like a top on its own axis and comes to a standstill a little lower down.

EACH BIRD KNOWS HER OWN EGG

My first impression as I looked at the colony of Murres crowded together on the shelf of rock was that the nesting must be communal. All about lay eggs so close together that one could hardly step without crushing them. Thousands of eggs, and yet no two alike! The combined effect was that of a whole spring flower garden of tints. Some were of a pure white ground color, others had various washes of gray or brown, and still others showed a dozen shades of blue.

Upon this ground was spread, in most instances, an elaborate pattern of splotches of all sizes and shapes, sometimes thicker on the large end and sometimes on the small end—splotches of brown, gray, and velvety black. Often they were marked all over. Some were daubed as with a brush; others scratched from end to end, as with a pen, and finished off with wild flourishes and scrawls. How, among so many, could any bird recognize her own?

How, in the vast throng of individuals, did she even find her own mate? To my dull human sight they all looked alike. I was unable to pick out a single bird that I could recognize if I turned away and looked back a moment later. And as

TWO YOUNG ROAD RUNNERS AT LUNCH

When a young Road Runner eats a lizard, he has a meal 10 or 12 inches long. He sits like a man with a board up his back and eats by inches, the lizard disappearing at the rate of about an inch every two minutes.

I watched them coming and going, it seemed to me at first as if each female was satisfied to plant herself on the first egg she found and, like any barnyard fowl, did not care a fig whether she or her neighbor had laid it.

But I soon became aware that such was not really the case. From my vantage ground I could see every movement in the ordinary run of life in the big colony without in any way disturbing the birds.

In order to discover whether or not it was within a Murre's limited intelligence to know her own egg, I experimented several times by scaring the birds from their nests and watching their return. Almost before I was hidden, the first Murre pitched awkwardly in. She sat for a few moments clucking and craning her neck, then hobbled up the rock past two eggs, bowing and looking about. She stumbled on as clumsily as a boy in a sack race, stopping and cocking her head from side to side like a nearsighted old lady, until she had passed eight or nine eggs. Finally she poked one gently with her bill, looked it over, and tucked it under her thigh. By this time the ledge was full of Murres, all cackling, pecking one another, and shuffling about in search for the one and only egg.

EVERY CHICK TO ITS OWN PARENT

Two years later I tried a similar experiment on the same colony when all the eggs were hatched. It had been noisy during the days of incubation, but it was bedlam when the Murres had young. As soon as the parents were scared from the nest, the infants began to squeal, and kept it up until the parents came back. When the first mother bird returned she bowed elaborately and uttered a series of calls varying in tone from the deep bass of a man's voice to the cackling of an old hen. After standing there for a few moments she straddled a few feet closer and began once more to bow and call.

Some of the young waddled down to meet their parents, squealing like a litter of pigs that had just been gunny-sacked. One crawled hurriedly down to get under an old Murre's wing, but she gave him a jab that knocked him backward and sent

A PET ROAD RUNNER SWALLOWING A LIZARD

A lizard is always eaten head first and when he once starts down a young Road Runner's throat, his scales prevent him from backing out. The head is digested first and in a short time the tail disappears with a final gulp (see text, page 201).

him looking for his real mother. She looked at two more that sat screaming, but passed them by and knocked another sprawling out of her way. At last a chick came up that seemed to qualify, for she let him crawl under her wing. Moreover, the same thing seemed to be going on in every part of the ledge, and I did not see any of the old birds accept a chick until after calling and looking around for several minutes.

The result of these experiments seems to prove that scientist right who, some years ago, claimed that nature has not lavished pigment on the Murre's egg without purpose, but that the wide variation in size, shape, and color undoubtedly helps the Murre to recognize her own. After the eggs are hatched, the difference in pitch, volume, and quality of the voices may tell the mother which chick belongs to her.

It is most interesting to watch the arrival of a Murre mate as he comes from the fishing ground to relieve the brooding mother. Sweeping in on swift wings, he begins to slacken speed when about 20 feet from the ledge, drops his legs, and back-paddles as awkwardly as a man who slips on a banana peel; and he lands sprawled out on the rock much as the man lands on the sidewalk.

Then, like a person anxious to penetrate a Fourth of July crowd, he looks for an opening in the dense front ranks. Seeing none, he boldly sets out to make one by squeezing in and shoving from right to left. The neighbors resent such behavior by pecking him, but he presses on, amid opposition and complaint, until he reaches his mate.

They change places and he begins his vigil on the egg. His mate, instead of taking flight from where she stands, usually goes through the same proceeding in reverse order until she reaches the outer edge of the rock and makes a quick launch seaward.

SEEKING THE HAUNTS OF THE WILD GEESE

When a boy I had watched the wedges of Geese cutting southward each autumn and the other flocks of wild fowl winging silently on their way. Each spring I

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A RUFOUS HUMMING BIRD TAKING LUNCH ON THE FLY

He dropped into the garden like a shooting star. By our filling the flower cups with sweetened water, he was lured to the geranium and "shot" by the camera man.

saw the bands returning. How these sights kindled my imagination, these processions, so full of mystery, that moved up and down the highway of the clouds!

The land where these flocks lived lured me like "castles in Spain." It was a lure I have never forgotten.

One spring we followed the trails across the southern tip of the Cascade Range from Ashland, Oregon. The morning of the fourth day we came down the eastern slope to the edge of a ridge that overlooked the basin of the Lower Klamath.

Stretching to the east and south, almost beyond the limit of vision, lay the marshes. The Klamath River threaded its way in and out of the green maze. Beyond were the Lower Klamath and Tule or Rhett Lakes, cutting at the lower end into the lava beds of northern California. To the northeast lay the great basin of the Upper Klamath.

Here lay the land of my dreams. After nearly 20 years of waiting, I was looking out over this place of mystery that lay far beyond the northern rim of my home hills.

From the distance where I stood the marsh was a level sea of green. As I discovered afterward, it was absolutely deceptive as to its real character. The ocean surface tells nothing of its thousand hidden wonders; so the marsh. The plain yields to the plow, the forest to the ax, but the unmeasured stretch of these tules is the same as when Lewis and Clark blazed a trail into the Oregon forest.

I hope the marsh will defy civilization to the end. The trapper and the hunter have plied the streams and the water of the lake itself, but the tules lie untouched, a maze forbidding, almost impenetrable.

The lure of the tule marsh was in its wildness. It is the ancestral nesting ground of many species of wild fowl.

We camped at the edge of the marsh that night, and early the next morning bailed out an old trapper's boat and paddled slowly down the right bank of the tule-lined river.

There were many sounds. The Red-winged and Yellow-headed Blackbirds fluttered in and out and swung on the bending tops of the tall cane. A male

A MEXICAN GROUND DOVE DEFENDING HER HOME

While a Dove is a shy and gentle bird, here is a case where the mother raised her wings and slapped the intruding finger whenever it came near her home.

Yellow-head lit on the tules just a few feet ahead. He began like the peeping of a young Duck, but, as his tail spread and his throat swelled, his song grew more violent, till it ended with a contortion like the complaint of an old sitting hen when she is disturbed. Some one has given this human interpretation to the song, which should be drawled out slowly: "Pop! goes the weasel."

As I edged silently along close to the reeds, I came to a turtle lying asleep on a water-soaked log. He didn't see me till I touched him on the back; then he awoke with a start and slid into the water. Once or twice I saw a snake glide away among the tules.

All the time I had been coming nearer to a place where a Bittern was pumping. He was a ventriloquist, for when I thought he was 20 feet away, I still sneaked 50 feet nearer. "Punk-a-lunk! Punk-a-lunk!" he said, but this pumping was only the end of the call. The beginning was a "blub, blub," like water bubbling down into a big empty cask.

As I pulled myself along by the over-hanging tules, suddenly I was face to face with the Bittern, and up he flapped with a frightened "quork."

At the next bend in the river I waded out through two feet of water to a small grassy island in the midst of the swamp. I was sure I would find Ducks' nests in a place like this, but a Duck's nest is not easy to find.

I had been wandering around for some little time, wondering why I could not find a nest, when suddenly a female Mallard flushed from between my feet. I had straddled a nest of 10 eggs before the mother flapped off lamely through the grass. I was surprised at the boldness with which she froze to the nest. It is a common trait. Twice during the morning I planted my feet within a few inches of a brooding Duck before she left her home.

Ducks are loath to reveal the location of their nests, but after the eggs are once discovered they become wilder, generally flying as one approaches within 15 or 20 feet.

The next day we started out again down the river. In the afternoon a bank

THE PORTRAIT OF A GREAT BLUE HERON FROM BELOW

The eyes of a Heron are in the lower sloping side of his head. He can stand as still as an old stick in the water and yet, without the side turn of his head, see a minnow that swims past his toes.

of clouds began to rise in the east, and we heard the distant peal of thunder. We hurriedly started back, but the wind was soon lashing the waves into whitecaps. Before long the advance drops began to strike us.

It was impossible in the midst of the marsh to haul the boat out and crawl under. The nearest cover was our small tent, two miles away; so we wrapped the cameras in our coats and put our strength to the oars.

We were suddenly enveloped in a shaft of green light as the sun broke through a rift in the clouds. There were green shades in the water, backed by the darkening of the pouring rain. Then over the wide stretch of the marsh the birds began to rise — white-winged Gulls, Red-head and Teal Ducks, all winging up and away to their nests and young.

Gaunt Cormorants lifted from the surface and beat along over the water, leaving a trail of little splashes in their wake. Terns began to cry and flit up from all sides, and here and there along the sedgy water's edge, a Bittern or a Night Heron rose with a frightened "Quork! Quork!" and was away with the gale. Blackbirds were all a-flutter, as the rain and hail began to pelt.

The whole surface was a-splatter with the flood of the clouds pounding the river below. Ahead and back and all about hung a misty spray from the clashing waters.

SLEEPING AMONG WATER FOWL

After spending two weeks along Klamath River, we set out overland for Klamath Falls, and then went to the town of Merrill, 20 miles south. Here we secured a staunch rowboat, loaded in our supply of provisions, and started down Lost River for Tule or Rhett Lake.

That night we camped at the mouth of the river, a great rendezvous for water fowl. Avocets were swooping past with a loud "Whit-whit-ie! Whit-whit-ie!" Stilts were crying "Quit! Quit!" loud and fast, and Killdeers running and flapping about in great distress. They kept crying long after we had crawled into our blankets and well into the night. The next morning we discovered the reason, for we found four nests of the Killdeer and five of the Stilts and Avocets near by.

Toward evening the Ducks came in from the lake in bands and settled down for the night where the reedy bogs lay scattered about and the water was shallow. At dusk we lay in camp and listened to the rush of wings, as the night-comers flocked in to their resting places. We could catch the faintest whir at first, which increased to a loud swish as the band passed. Out on the water came the light flappings, as flock after flock settled for the night.

After five days we set out across Tule Lake, and after rowing several hours came to the peninsula at the southeast end. This, as well as the other region to the south, is of volcanic origin. The shore is rough and precipitous. In some places the cliffs start abruptly from the water's edge; in others disintegration has been rapid, the rocks shaling off and rolling down until there is a long, steep slope of crumbly débris in which it seems impossible for anything to grow. Yet in places these slopes are massed with California poppies.

That night we camped just below the crater of an extinct volcano and early the next morning paddled out to a rocky island containing a colony of Farallone Cormorants. In a space of 25 or 50 feet we counted 190 nests, containing about 300 young birds and half as many eggs.

Rowing past Rattlesnake Island, we came to Bloody Point, a butte of red lava almost entirely covered with poppies.

In the afternoon we made camp across from another large colony where Cormorants and White Pelicans were nesting. The Cormorant nests were built of sticks. The Pelicans merely made depressions in the sand for their eggs. In addition to bird residents, the island was well stocked with fleas.

CAMPING IN THE MARSHES OF AN ALKALI LAKE

When we returned to Merrill we loaded our boat into a wagon and hauled it to White Lake, a long body of alkali water that empties into the Lower Klamath at the southeast end.

The Lower Klamath is very different from the south end of Tule Lake. The whole border is an impenetrable jungle. Tules grow from 10 to 12 feet high. One can never get to a point where he can look out above the tops and see where he is going. The foundation is made of decayed vegetation and is treacherous to tread upon. In places the roots form quite a substantial raft. One may walk across the wavy surface, but any moment he is liable to sink in over his head.

Extending for several miles out from the main shore was a seemingly endless area of floating tule islands, between which flowed a network of channels. The

A SEASCAPE ON THE CALIFORNIA COAST

A Gull is a master of the air. He can float on poised wings and at the same time reach forward with his foot and scratch his ear (see text, page 181).

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"GRANNY" BARN OWL

The eyes of the Owl are not in the side of the head, like those of the Sparrow, but in front, like the eyes of a man. An Owl has extraordinary organs of sight, for he can adjust them to see during the day or in the dark of the night.

tules had grown up for several generations. The heavy growth of each year shoots up through the dead stalks of the preceding season. On the top of this the Pelicans, Gulls, Cormorants, and Terns had perched and trodden down the tules. These precarious footholds were our only camping spots during the two weeks we cruised the Lower Klamath.

These days were full of hardship. The water of the lake contained so much sediment and alkali that it had to be boiled, while the only fuel we had was the little we carried in the boat.

The first morning out, we tried wetting down the tules and making a small fire on top. Before we could get anything cooked, the whole foundation was ablaze and coffee-pot and frying-pan had to be used to check the flames. After that we always sought a place where the tules could be cleared away and a fire made on the water-soaked roots even with the surface of the water.

"TWO'S COMPANY"

For ages the Owl was regarded by superstitious people as an ill-omened bird of prey. You may judge for yourself whether they are spooky or just spoony. These Barn Owls are the night police about the farm to keep mice and gophers in check.

The thick growth of tules made an excellent mattress. By spreading sleeping-bags on top of a high bunch and rolling in carefully, we generally had a good bed for the night. In the early part of the evening we were two or three feet above the surface, but by morning we had sunk down just about to water level.

The largest bird colonies of this region are located on the west side of the lake. In one place, for half a mile, the Western Grebes, White Pelicans, Farallone Cormorants, Great Blue Herons, California and Ring-billed Gulls, and Caspian Terns had combined, as it were, to form one of the most extensive bird colonies we had ever seen.

To the east of the Klamath lakes are other large alkaline bodies of water where water fowl abound—Summer, Abert, Goose, Warners, Harney, and Malheur lakes. In the spring of 1908 we started into the Malheur country, which is historic ground for a bird man. In the early seventies the well-known ornithologist, Captain Charles Bendire, was stationed at Camp Harney, on the southern slope of the Blue Mountains. He saw the wonderful sights of the nesting multitudes on Malheur and gave the first account of the bird life in that region.

On the south side of the lake, at the site of the historical old Sod House, a large spring rises at the base of the grav-

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THE CONDOR SMILE

The California Condor is a bird of slow growth; it takes more than six months to develop from egghood to full flight. This bird lived in the New York Zoölogical Park until 11 years old.

elly hill and winds out through the meadow land. For a mile it meanders along till it comes to the main part of the tule marsh—thousands of floating islands, between which flow narrow channels that are endless in their windings.

The main body of the lake is still a mile beyond the place where the spring branch enters the tule jungle. The tules grow 12 feet high; so that when one enters the mass he has no landmarks unless, perchance, he can read signs in the heavens.

We launched our flatboat in the spring branch and set out, anxious to get the lay of the land and see some of the birds. We passed from the spring branch into the serpentine meanderings among the tules.

LOST AMONG TULE ISLANDS

In one place I heard a pair of Sora Rails chattering anxiously. We shoved the nose of the boat into the tule mass that covered the water like an immense haycock. As I crawled out over the bow and stepped on the springy mass, the

footing seemed safe, for I did not sink in above my shoes. One needed a pair of snow-shoes to walk on the surface.

By throwing myself forward and gathering under me an armful of buoyant tules, I made my way for 20 feet, with the excited pair of Rails leading me on. Suddenly I struck a weak place in the tule floor and I dropped into the muck beyond my middle. With the aid of an oar that was thrown to me, I struggled back to the boat.

We were now in danger of losing our way. A little farther on I left my handkerchief on top of a bunch of tules for a signpost. Still farther I stuck up a pole to mark our way back.

"We'll pick these up on our return," I said.

We swung around a tule island, working back in the direction from which we had come.

"I am beginning to lose my bearings," said my companion. I had already lost mine.

My first trip to Boston, that took me underground, overground, and up and down crooked streets, was as clear as wandering down a country lane in comparison to the embarrassment I felt when I tried to find my way in the narrow, walled-in, Venetian streets that circled these islands like a maze for about 10 miles east and west.

"The thing to do is to go back over the same track we came," I ventured. So we immediately turned about and spent the rest of the afternoon in trying to do it; but we never saw the handkerchief or the pole again.

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THE TUFTED PUFFIN, OR SEA PARROT

He has developed a powerful bill in feeding on shellfish. His face looks like the prow of a battleship. If you get too close, he will take your finger as quickly as he takes a fish (see text, page 181).

We had no food, nothing to drink but alkali water, and were wet, with no chance of getting dry; we *had* to find our way out. The sun was setting, so we knew east from west. We paddled as nearly as possible in the direction in which we had come. When at last we reached the end of a blind channel, where the tules seemed firmer, we decided to cut for shore by the shortest route. We floundered through the tules, sinking in the black muck of the marsh for some distance, and were suddenly confronted by a deep slough.

"Even the old tub of a boat looks better than this," said my companion.

MAKING FRIENDS WITH YOUNG BURROWING OWLS

These are most valuable birds in the farming districts of the West, because they catch great numbers of field mice, squirrels, and other small ground animals that do damage to crops. These three birds were taken out of a burrow and were soon on friendly terms.

We turned back again.

As the clumsy craft floated out into the channel and I sat straddling the bow, dangling my feet in the water to get rid of the mud, it seemed as if Nature had surely done her best to make the tule swamp unfit for man. The Rails ran lightly through the jungle, the Blue Herons stood fishing in the marginal water, the Red-wings and Tule Wrens clung to the swaying stems, the muskrats paddled homeward with tails waving contentedly to and fro; they all had places to sleep.

Darkness settled over the marsh. The stars glittered, the wind whispered in the tule tops, the birds were asleep.

It was almost noon the next day when by chance we struck the channel that led us out of the maze and back to camp. But we had learned the art of blazing a trail that we could follow through the tules, and after resting a day from our initial efforts we outfitted for a week's trip and set out down the spring branch. This time we kept a straight course to the north until we reached the main body of the lake.

Along the southeast side of the lake we discovered great colonies where White Pelicans, California and Ring-billed Gulls, Caspian Terns, and Great Blue Herons were nesting. Over on the north side were immense colonies of Western Grebes, Eared Grebes, Black-crowned Night Herons, and White-faced Glossy Ibis.

We were hunting mainly for colonies of American Egrets, or White Herons, which were formerly common on the lake. After a month's search we saw two flying over. They had been practically exterminated by plume-hunters.

Our expeditions into the Klamath and Malheur Lake countries were taken at the suggestion of Mr. William Dutcher, President of the National Association of Audubon Societies, partly with the idea of putting an end to the slaughter of wild birds in those sections, which were being killed to furnish plumes for the millinery markets. Upon our report of conditions, President Roosevelt issued a special proclamation on August 8, 1908, setting aside Lower Klamath Lake as a special reservation for the protection of

wild birds. A second proclamation was issued August 18, 1908, establishing Malheur Lake Reservation.

These two reservations are among the most important ever established, because of their wide marsh areas and the numbers of birds protected. Previous to this, October 14, 1907, President Roosevelt had created Three Arch Rocks Reservation, which was the first land set aside on the Pacific Coast solely for the protection of wild birds.

HUNTING THE CALIFORNIA CONDOR

From a scientific standpoint, our photographic life history of the California Condor has been the rarest and most important work we have done. This was accomplished in 1906. After a long search, we found the home of the Condor in one of the mountain ranges of southern California.

"A BIRD IN THE HAND"

A friendly Desert Sparrow at Tucson, Arizona. Birds are trustful if we are kind to them. They are wild because they have been persecuted so long.

The advance of civilization has all but led to the extinction of the species. If one were to start on a hunt for the California Condor, he might search for years, as we did, without success. In the whole world's collections, there are not a half dozen of these birds alive. In the various museums of the world one can find almost twice as many eggs of the Great Auk, a bird now extinct, as of this Condor. A few left in the wild state live almost entirely in the Coast mountains of southern California and a part of Lower California.

The report that the California Condor is rapidly following the Great Auk, the Labrador Duck, and other species, and that it will soon become extinct, is not without foundation. Its range is more restricted than that of any other bird of prey. In the early part of the last century it was reported fairly common as far north as the Columbia River region.

The main cause for the decrease in Condor numbers seems to be that when stock-raising became common in California, years ago, in order to secure pasturage during the dry months, the rangers were compelled to drive their herds back into the more remote mountainous parts. Here they invaded the retreats of panthers, grizzlies, and coyotes. These preyed upon calves and sheep. The quickest and best device for getting rid

A PET CALIFORNIA CONDOR

He was fond of playing in the sand by the river and sunning himself. He liked company and followed the camera man around like a household pet.

of these animals was by baiting the carcasses with poison. Since Condors came to feed on carcasses, many of these birds were killed in this way.

CONDORS RAISE ONLY ONE BIRD A YEAR

The Turkey Vulture has held its own in the struggle for existence against these forces, but the Condor is slow in recuperating its numbers. Even under favorable conditions, each pair of Condors will raise only one young bird a year. There is no existing authentic record of a California Condor laying more than a single egg at a sitting. One collector states that in a certain locality where a pair of these birds live, they have nested but three times in 12 years.

Under these conditions, it is not surprising that Condor numbers have decreased, and unless careful protection is given, the bird will soon follow the Great Auk.

The Condor egg which we found on March 10 was hatched on March 22.

During the months of April, May, June, and July we made frequent pilgrimages back over the rough mountain trails to this rocky shrine in order to study the home life of these birds and to watch the growth of the young Condor. On July 5, when the young Condor was about three and a half months old, he weighed 15 pounds. In order to complete our studies, we took the nestling to our Oregon home. It was not until the middle of August that he was well fledged, except that his breast was still covered with gray down. With his wings extended, he measured almost nine feet.

The slow growth of the Condor is shown by the fact that from the time the single egg is laid it takes a full six months or more for the parents to raise their offspring. In the case of a Sparrow or Robin, the time required for rearing a family is less than one month.

On September 28 the young Condor was sent to the New York Zoölogical Park, where he was well cared for and lived to the age of 11 years (see p. 194).

The Condor of the Andes has long been considered the largest bird that flies. It averages about 10 feet from tip to tip,

when the wings are spread, and weighs from 20 to 25 pounds. The California Condor will average the same.

The South American Condor is glossy black, with a broad white bar across each wing, and has a ruff of white down about the neck. The head is unfeathered and is covered with wrinkled red skin. The forehead has a cartilaginous comb or caruncle, and the throat is wattled like that of a common Turkey.

The California Condor is blackish in color, with the feathers of the back edged with brown. There is no caruncle on the head, but about the neck are loose black lancelinear feathers. The lining of the wings is white, and when the bird is soaring this mark distinguishes it from the Turkey Buzzard.

A DOWNY YOUNG TURKEY VULTURE

He has the reputation of being a lost soul in the bird world. He is a bird of prey, but, with a foot like a Chicken, he cannot clutch and hunt like a Hawk or Eagle. He does not hunt living things; he plays a waiting game.

The size and strength of the Condor have often been exaggerated. There have been many absurd stories about these birds killing sheep and other animals. Dr. Alexander Taylor, who gave the best early account of the Condor, said that it had been known to kill and carry off a hare in its claws.

The habit of the Vulture is to wait till after death, and it is extremely doubtful that one of these birds would ever attack a living animal.

THE BIGGEST BIRD THAT FLIES WAS "AS GENTLE AS A KITTEN"

As to the Condor's carrying its prey, this is easily discredited by a study of its foot. The claws are blunt and weak, and the foot is not adapted for grasping or carrying like that of an ordinary bird of prey.

In our study of the Condors at home, the most surprising thing to us was that this biggest of all birds, which has often been reported as wary and ferocious, was as gentle as a kitten. From such information as I had gathered about the California Condor, I should never have believed that we could get so close to this pair of big birds in the wild state. After our many visits, they had evidently got acquainted with us and knew that we would not harm them.

THE DINNER CALL IN THE RED-WINGED BLACKBIRD HOME

His black body and scarlet shoulder patches cause the Red-wing to be easily recognized about ponds and marshes of all parts of our country. He likes to tie his home in the reeds a foot or so above the water.

Both parents were very solicitous for the young bird in the cave. Several times, as we sat at the entrance very quietly, one of the parents, perhaps the mother, edged up within three feet.

The most surprising thing in all my bird experience was when the mother reached over and nibbled the sleeve of the camera man. Both old birds were near by. Occasionally they would caress each other.

To test the parents further, the camera man reached down into the cave, and when the young Condor began to hiss, the mother edged down and nipped the camera man gently on the gloved hand.

He loosed the glove slightly and she began tugging at it. He let the glove slip from his hand, and for a moment it hung in her bill; then she laid it at her feet.

HUNTING BIRDS IN THE ARIZONA DESERT

At first sight one might not select the desert as a retreat for a bird-lover. A friend who had lived in Arizona told us

there were no birds in the desert. She had been there two months and had scarcely seen a bird, she said. But perhaps she did not have an eye single to bird study. When one travels 2,000 miles to hunt birds with a camera, he is likely to find them, even in the desert.

One spring Mrs. Finley and I went to Arizona to study and photograph the birds of the desert. At Tucson we bought a horse and light buggy. For three months we wandered about day after day, through the cactus and along the old river bottoms, making friends with the birds.

The problems of the desert are intensely interesting to a naturalist. Take it from nearly every standpoint, Mother Nature is strict and harsh with all her children of the desert. Life is spent on the march or in the firing line. Nearly everything is fortified with thorns.

The cactus has a panoply of points to protect its soft, spongy meat; the mesquite, the paloverde, and the delicate white poppy clothe themselves in thorns.

The pudgy toad in our Oregon garden grows fat and lazy, but he wouldn't last long in Arizona. Out on the desert, Nature arms her "toads" and lizards in thorns and scales. The "toad" grows flat and thin, can run like a streak, and digs a hiding place in the sand. He wears a crown of thorns and is really a lizard instead of a toad.

Out in the desert we found birds in abundance: Road Runners, Verdins, Gnatcatchers, and three kinds of Thrashers—Palmer, Bendire, and Crissal. The river bottoms were always full of song, for there were numbers of Mocking Birds, Chats, Cardinals, Tanagers, Warblers, Towhees, Flycatchers, House Finches, and four varieties of Doves—Mourning, Inca, Mexican Ground, and White-winged.

THE AUTOMOBILE DEFEATS THE ROAD RUNNER

The Road Runner is, perhaps, the most striking character of the cactus belt. He has a variety of names—Ground Cuckoo, Mexican Paisano, Snake-killer, Chaparral Cock, and Cock-of-the-Desert.

When we first went to Arizona we were anxious to find a Road Runner. We found several old nests and occasionally we would catch a glimpse of a slim, long-tailed bird running through the cactus.

One day, when we least expected it, a Road Runner slid across the road, hopped up into a cholla cactus, and was instantly lost to sight in the thorny mass. We drove around the bush slowly, once, twice; closer and closer till we could see through the tangle. But no Road Runner! She had disappeared, and yet she could hardly have escaped without our seeing her. A slight movement in the cactus—there she was, sitting bolt upright, holding a lizard in her bill. Until she moved, she was as completely hidden as if she had not been there.

I have occasionally seen an old Road Runner that takes a delight in outdistancing a team of horses, but the bird is not accustomed to our modern method of traveling.

One day a friend was spinning down the Oracle Road in his automobile, when at the turn a Road Runner dropped into line ahead and set the pace down the smooth stretch. The driver turned on a little more gasoline. The bird looked over his tail at the horseless carriage. It was gaining on him.

As the machine bore down on the astonished bird, he became scared. He cocked his tail suddenly to put on the brake, made a sharp turn to the left, dodged into the cactus and creosote bush, and away he went, at top speed, as far as he could be seen.

While some people accuse the Road Runner of killing other birds, especially young Quail, our experience showed that he lived almost entirely on lizards. The young birds in the nest were fed on lizards from the time they were out of the egg. The reptile was always killed and thrust head down into the mouth of the youngster. The tail hung out of his mouth for a time, but as the head was digested the young bird gulped a little now and then, until finally the end of the tail disappeared (see pages 167, 186, and 187).

Photograph by Byron Cummings

REMOVING THE COVERING FROM THE SLOPE OF SAN CUICUILCO

The excavations conducted by Dr. Manuel Gamio, director of anthropology in the Bureau of Agriculture and Public Works of Mexico, and Prof. Byron Cummings have proved thus far that San Cuicuilco is an artificial mound covered by the accumulations of ages. Its original structure was a truncated cone 412 feet in diameter and 52 feet in height (see text, page 209).

RUINS OF CUICUILCO MAY REVOLUTIONIZE OUR HISTORY OF ANCIENT AMERICA

Lofty Mound Sealed and Preserved by Great Lava Flow for Perhaps Seventy Centuries is Now Being Excavated in Mexico

By Byron Cummings

Professor of Archeology, University of Arizona

ABOUT 1,000 years before Pharaoh was driving his slaves to the construction of the Great Pyramid of Egypt, and some 5,000 years before the Assyrians were mixing their sweat with the mortar that held the bricks of the great palace of Sennacherib together, some ancient Indian chief of the Valley of Mexico was forcing his subjects and slaves to rear a mighty structure on which to honor the gods of his land.

The inhabitants of the Mesopotamian plains raised lofty platforms and extensive palaces to honor the living rulers of their domain; the people of the Valley of the Nile built massive pyramids to serve as tombs for their political and religious masters; but in Mexico the multitude toiled and slaved to build great pyramids on commanding sites which might serve as temples to their gods.

A VALLEY BAPTIZED WITH FIRE

The Valley of Mexico seems guarded from outside intrusion by a ridge of mountains along which rises many a rounded crater that speaks forcefully of the repeated baptisms of fire which Mother Earth has poured out upon this choice spot.

While the destruction wrought by these visitations of wrath of the fire god has evidently been terrific, yet the earth thus enriched became a veritable treasure-house, which needed only to be touched to yield vast stores for the delight of man.

Here has been a Garden of Eden, where the gods loved to linger and experiment with various stocks and successive generations of men.

Just west of the pass that leads from the Valley of Mexico over into the Valley of Cuernavaca, rises the irregular crest of old Ajusco, from whose lofty craters have poured many showers of ashes and pumice and many streams of lava to envelop the plains below (see map, page 207).

The most recent of these craters is a huge bowl, some 1,500 feet in diameter and 300 feet deep, rising from the northern slope of the Ajusco group, about 10 miles south of Tlalpam. The round wooded crest of this crater, called Xitli, forms a striking landmark above and to the right of the railroad as one climbs toward the crest of the pass in going from Mexico City to Cuernavaca.

Over the rim of this great bowl poured a stream of black lava that flowed down the northern slope of the mountain and out into the fertile valley below.

Its seething current swept on like some mighty fire-breathing dragon, carrying death and destruction to all living things in its path.

This stream flowed past Zacatepec, one of the hills reared by some former eruption of the higher craters of Ajusco, to the borders of San Angel on the north and to the outskirts of Tlalpam on the east.

As it slowly swept on toward the northeast, it crept entirely around and tried to climb the slopes of a low hill which the natives to-day call San Cuicuilco.

LAVA FLOW MAY HAVE OCCURRED 7,000 YEARS AGO

This great tongue of black, flinty lava, called the Pedregal (meaning "Stony Place"), some 15 miles long and 3 miles wide, varies in depth from 5 to 30 feet. Its surface is wrinkled and twisted and seamed by many a deep crack, broken gorge, and yawning cistern. Its hard, rough surface grins defiance at the ages, and the trails across its expanse, used by

Photograph by Byron Cummings

THE SOUTHEASTERN SIDE OF CUICUILCO, SHOWING THE SLOPE ABOVE THE PEDREGAL LAVA AND THE SUSTAINING WALL, BUILT AFTER THE STRUCTURE HAD BEEN COVERED WITH 18½ FEET OF VOLCANIC SAND

THE FIRST PIECE OF WALL UNCOVERED AT CUICUILCO UNDERNEATH THE VOLCANIC DEPOSITS

SHOWING THE DEPTH OF THE VOLCANIC DEPOSIT COVERING THE TOP AND UPPER TERRACE

Photographs by Byron Cummings

Photograph by Byron Cummings

UNCOVERING THE BASE OF THE MOUND WHICH LIES 25 FEET BELOW THE LAVA OF THE PEDREGAL

Geologists' estimates of the date of the lava flow at Cuicuilco vary from 5,000 years before the Christian Era to about 2,000 years ago. The artificial mound was probably ancient when the volcanic eruption occurred.

the natives for centuries, show very little wear.

Geologists have traveled around the Pedregal and stumbled across its sharp, craggy surface; have studied its flora and the weathering of its watercourses and arrived at widely different conclusions as to the time when the lava flow occurred.

The latest authority to put himself on record in an estimate of its position in our chronology is Mr George E. Hyde, a geologist from New Zealand, who spent the winter of 1921-22 in a study of the Valley of Mexico for the Mexican Government.

Mr. Hyde declares that the Pedregal must have been deposited at least 7,000 years ago, or some 5,000 years B. C. The latest period assigned to it is some 2,000 years ago, or about the beginning of the Christian Era.

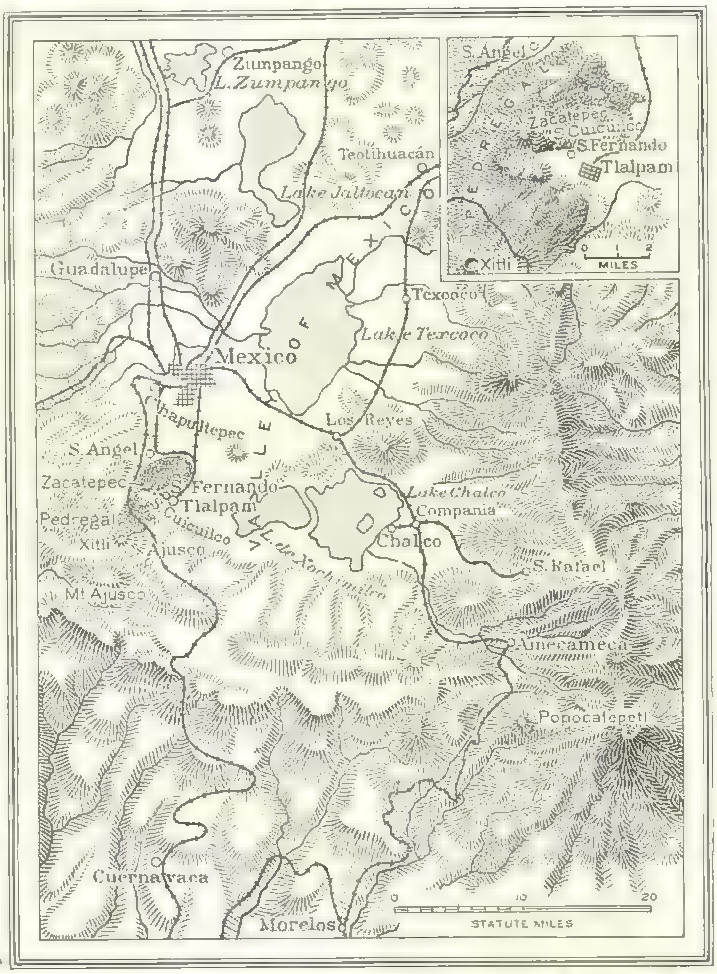
Since no tradition regarding the eruption of Xitli seems to have survived among the Aztecs or other Indians of the region, and since the external evidences of the Pedregal itself indicate a long

period of weathering, is it not quite as reasonable to assign the earlier date to a catastrophe fraught with such terrible consequences that its memory would have survived through many, many generations of men?

It is evident that before the eruption of Xitli a numerous population occupied this part of the valley, and if the cap of lava, known as the Pedregal, could be removed the ruins of houses and villages would be disclosed.*

The hill of San Cuicuilco, which we have already mentioned as surrounded by this lava flow, is situated near the village of San Fernando, a part of Tlalpam, which is a thriving town situated about 12 miles south of Mexico City at the northern base of Mount Ajusco.

Dr. Manuel Gamio, director of anthropology in the Bureau of Agriculture and Public Works of Mexico, had noticed this lava-surrounded hill and invited the writer to examine it with him. The result of the visit was a plan for the investigation and excavation of the mound.



Drawn by A. H. Bumstead

A SKETCH MAP SHOWING THE LOCATION OF CUICUILCO AND THE PEDREGAL LAVA FLOW WHICH HAS PRESERVED THE ANCIENT MOUND

The Government of Mexico, through Dr. Gamio's department, agreed to furnish the men and materials necessary for the work, and the writer took charge of the excavations and the collection of data.†

A few days after we began operations, some of the workmen declared that at 6 o'clock on the 4th of May a light danced above the top of San Cuicuilco and then passed slowly across the Pedregal to the crest of Zacatepec, another hill lying to the west. This was accepted by the

*At San Angel the Mexican Government has carried on extensive investigations beneath the lava of the Pedregal. Numerous tunnels have brought to light several skeletons, many pieces of pottery, and many stone implements. The artifacts disclose a culture that the Mexican archeologists class as archaic and which, according to universal classification, belongs to the early neolithic culture of the Stone Age. At other points on the edge of the Pedregal similar articles of human workmanship have been encountered.

† The Mexican Government extended every courtesy during the work of excavation and fulfilled all its promises. It speaks eloquently for the farsighted and enlightened interest of the present administration in Mexico that it is willing to provide from its limited revenues for carrying forward scientific investigation.

The writer had intelligent and happy cooperation from Dr. Gamio and his department, and hopes that the years to come may see a greater sympathy, a better understanding, and a larger coöperation established between the people of Mexico and those of the United States, especially among the scholars of the two countries.—B. C.

Photograph by Byron Cummings

TRENCHING TO DISCOVER THE BASE OF CUICUILCO

When the work of excavation began, the rumor spread that the investigators were seeking treasure buried either by the Aztecs or by the Spaniards, and often outsiders stole into the workings and tried to excavate also.

laborers as evidence that there was treasure in both hills, and from that time on many were the stories circulated of treasure buried in the hill by Aztecs and Spaniards.

The Spaniards and mestizos especially watched our operations with eagle eye and constant attention. At times, as we reached places that seemed to them particularly favorable, they stole into our workings and tried to excavate.

Some declared that an ancient chief had been driven to the Pedregal by the Aztecs and had gathered his followers about him and prospered in spite of the inhospitable surroundings. There he was buried with great treasure and this mound raised over him. Others vowed that the Spaniards, at times of civil strife, before a stable government was established, hid treasure in San Cuicuilco that had never been recovered.

This lava-covered plain has ever been a place of refuge for criminals, revolutionists, and those out of harmony with the dominant political party. Many a man can point out the caverns that sheltered him and perhaps his whole family for weeks and months. Even now the people living near it seldom venture out alone after nightfall.

But, as the work progressed, most of the people came to realize the truth of our statements: that the builders of Cuicuilco had neither gold nor silver and were

blessed with very little else that could be counted valuable to-day.

A GIGANTIC ARTIFICIAL MOUND RAISED BY ANCIENT AMERICANS

San Cuicuilco has more than fulfilled expectations. It has proved to be an artificial mound covered by the long accumulation of ages. Its original structure was a truncated cone 412 feet in diameter and 52 feet in height. The rounded shape of the pile is in keeping with the circular form of all the most primitive homes.

The top forms a broad platform 290 feet in diameter, probably a place for ceremonial dances. The name Cuicuilco, an Indian word handed down from the past, suggests singing and dancing, the two great essentials of religious ceremonies for primitive Americans.

This structure consists of an outer wall of rock 70 feet thick at the top with a central core of filled earth. This thick wall is composed of chunks and shells of lava compactly piled.

The outer surface inclines at an average angle of 45 degrees and consists of large unhewn blocks of lava, many three and four feet in length, with the smaller end pointing toward the center at right angles to the surface and bedded in smaller lava shells.

The style of the surface masonry is crude cyclopean, and very little attempt was made to present a flat surface of the boulder to the outside. Holes were filled with smaller stone or, where the rocks seemed sufficiently solid, were left open. No other filling material of any kind was used.

No attempt had been made to chip the rough blocks to make them fit better or provide smoother exterior surfaces. The inclination of the surface and the weight of the dense chunks of basalt and andesite have kept the wall intact and only small portions of the edges had been shaken from their positions before the structure was covered.

The base of the cone lies 25 feet below the present surface of the surrounding terrain and the top platform is covered by 18 feet of volcanic material.

On the terraces, and still clinging to the slopes in many places, is encountered similar volcanic material. Over this is a covering of vegetable loam and clay that

AN ALMOND-EYED MAIDEN FROM CUICUILCO

Photographs by Byron Cummings

TYPE OF POTTERY RECOVERED FROM BENEATH THE CUICUILCO LAVA

This piece of earthenware had been buried for probably more than 7,000 years.

Photograph by Byron Cummings

EMBLEMS OF THE FIRE GOD DISCOVERED BENEATH THE LAVA

Photograph from Byron Cummings

THE AUTHOR EXAMINING THE GOD OF FIRE, FOUND AT CUICUILCO

These clay figurines and idols show the beginning of the mastery of materials and the coming of trained hands, eyes, and intellects (see text, page 213).

Photograph by Byron Cummings

AN ANCIENT INHABITANT OF CUICUILCO

His remains had lain for probably more than 7,000 years beneath the lava flow.

the recurring rainy and dry seasons of the centuries have accumulated.

Large time-honored pepper trees flourish on the summit or strike their roots deep into the sustaining walls that some later generations of men have built along the slopes.

In these walls and in a large pile of rock and earth found on the southwestern side of the platform appear many waterworn boulders that must have come from the bed of some river now lying beneath the Pedregal lava.

LAVA BOULDERS USED IN BUILDING MOUND ANTEDATED PEDREGAL LAVA

In the center of the top platform and beneath eight feet of volcanic material and surface loam stands a crude altar of waterworn boulders and clay. It is 22 feet long and 9 feet wide. The corners are rounded and the eastern half is a platform raised two feet above the floor of the western half and surrounded by a wall that raises its outer edge one foot higher. This portion is in the form of a horseshoe with its open end pointing a trifle south of west (see page 215).

The whole rests upon a platform of large lava boulders bedded in sand and clay. This platform in turn rests upon a hard clay floor that has been beaten down, smoothed, and polished by the tread of many generations of men.

The rock and clay platform has a diameter of 55 feet, but the extent of the clay floor beneath has not yet been determined. Beneath this clay pavement are two others, the lowest at the level of the original platform of the truncated cone.

The lava rock found in every part of the structure—in the more recent as well as in the most ancient—is of a flow that antedates that of the Pedregal, which, as stated on page 206, occurred many thousands of years ago. Not a piece of the Pedregal lava has been found in any of the walls or even in the pile of earth and rock encountered on the top.

Lying scattered about its base are chunks and shells of lava of a type similar to that found in the structure. They seem to have rolled down the slopes from the edges of the walls above and accumulated in a great mass at the bottom. Above these lie from 12 to 15 feet of volcanic

Photograph by Byron Cummings

A CRUDE HUMAN FACE PECKED ON THE SURFACE OF A HARD BOULDER, FOUND AT CUICUILCO

material similar to that covering the top platform and the terraces.

This accumulation is thickest at the base and diminishes in depth as it extends up the sloping walls to the first terrace. Above this is a mass of clayey loam filled with lava boulders that have rolled down from the broken terrace walls of the later construction.

MOUND SEALED AND PRESERVED THROUGH COUNTLESS CENTURIES BY LAVA

At the bottom of this accumulation of surface loam and rock is a stratum, varying in depth from 5 to 18 inches, of charred and blackened material, the product of severe heat. Under the lava it is a crisp mass, with here and there a pocket of black sand or ashes.

On every side are encountered the black, forbidding faces of the Pedregal, which pressed their numerous noses against the covering of old Cuicuilco until they were flattened and rounded and buried deep in its yielding soil. In some places, where the more gentle slope of the covering permitted, the many-headed lava monster climbed up the slope, burying the base far beneath and holding the great temple in its ironlike embrace.

From the eastern side a great platform 30 feet long and 70 feet wide extended down on an incline from the first terrace. Most of its walls had fallen and been buried beneath wind-swept dust and ashes before the Pedregal lava crept up over them to a distance of 10 feet.

These 15 to 17 feet of sand, clay, and rock that had accumulated above the surrounding pavement of Cuicuilco before the lava flow occurred, demonstrate that *its builders had lived and worked thousands of years before the Pedregal had formed.*

It is reasonable, then, to assume that this temple was reared by primitive Americans who lived some 8,000 or more years ago.

Thus the forces beneath old Ajusco volcano have been laboring for ages effectively to seal up and preserve this handiwork of ancient Americans.

EXCAVATIONS MAY REVOLUTIONIZE OUR CONCEPTION OF ANCIENT AMERICA

Time is a wonderful leveler and Nature is also ofttimes a remarkable preserver, saving the records of the world's progress that men may be stimulated to deeper investigation of her forces and of the part man has played in the understanding and mastery of those forces and the materials they produce.

Cuicuilco presents to us to-day positively and forcefully a chapter of human history on the American Continent that many have supposed never existed. Its rough, massive walls and simple outlines show the beginning of public architecture in North America. Its extensive proportions and great mass of material are evidences of early political and social organization, and demonstrate the won-

Photograph by Byron Cummings

UNCOVERING THE SLOPE

derful results of human coöperation in primitive society.

Its chipped or roughly ground stone implements, its crude pottery with an occasional attempt at decoration by incised lines and dots or awkwardly molded relief, its childlike attempt to represent the human form in clay figurines and idols, all show the beginning of the mastery of materials and the coming of trained hands, eyes, and intellects.

Cuicuilco is not spectacular. It does not astonish us with its beautifully hewn masonry or its skillfully carved façades and painted friezes. Its architecture was massive and simple, dedicated to the mighty forces of earth and air. Its decorations were meager and crude. Man had not yet reached that stage in which his imagination ran riot and controlled his activities, and his hand had not yet acquired sufficient skill and mastery to interpret his aspirations to his fellow men. Ages had to pass as man slowly groped his way toward a realm of broader understanding of himself and his universe and toward a more varied and more real expression of what he felt and what he saw about him.

CUICUILCO THE FORERUNNER OF ORNATE AMERICAN ARCHITECTURE

Cuicuilco represents the results of stolid, vigorous Youth, Youth just beginning to feel his strength and daring occasionally to straighten up and ask the spirits to teach him.

This edifice is the foundation upon which was built that massive and ornate American architecture whose ruins dot nearly every height, plain, and valley from Zacatecas to Panama and from Guerrero to Yucatan. Its walls are rough and massive, yet preserve a beauty of line

A CLAY PLATFORM PAINTED RED FOUND BENEATH THE ROCK PLATFORM IN THE CENTER OF THE TOP OF THE CUICUILCO STRUCTURE. THIS MAY HAVE BEEN AN ALTAR

Photographs by Byron Cummings

UNCOVERING THE EASTERN SLOPE OF CUICUILCO

Photograph by Byron Cummings

THE HORSESHOE ALTAR

This photograph was taken from the top of Cuicuilco, looking south toward Xitli, the crater from which came the Pedregal lava flow (see text, page 203).

that undoubtedly inspired the descendants of its builders to create the mighty pyramids, the wide paved plazas, the beautifully decorated halls of Teotihuacán (see illustration, page 216).

The Pyramid of the Sun, the Ciudadela, and the ornate Temple of Quetzalcóatl, as shown in the illustration on page 218, all speak forcefully of the wonderful organization of the Toltecs and the great skill their artisans had acquired. As in the ancient lands bordering on the Mediterranean, one can trace the development of the builders' and decorators' art from the crude cyclopean masonry of Tiryns to the beautiful Temple of Athena on the Acropolis at Athens, so, just as truly, can one follow the course of the development of ancient American architecture and architectural decoration in the Valley of Mexico.

Here was a land of human achievement that left a record extending far back into the dim beginnings of man's attempts to understand himself and to establish the proper relations with the forces operating about him. Does this American record of human endeavor suffer by comparison with that of ancient Egypt or far-famed Greece?

HUMAN HISTORY IN AMERICA BEGAN MILLENNIUMS BEFORE BIRTH OF CHRIST

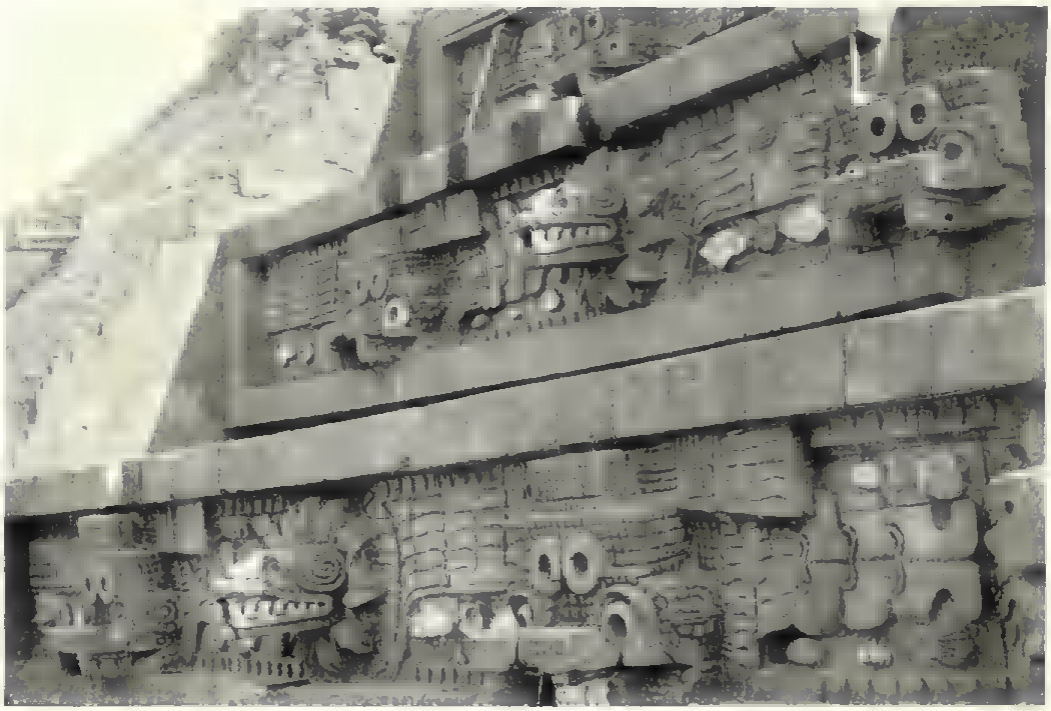
The indications deduced from the investigation of the various American Indian languages and the facts presented by old Cuicuilco agree that human history in North America began thousands of years before the Christian Era.

Wherever the first ancestors of the native American may have arisen, it is certain that that same native American had populated extensively certain portions of our continent when he had attained only

Photograph by L. H. MacDaniels

ONE OF THE TEMPLE STAIRS AT TEOTIHUACÁN

The pyramids at this ancient Toltec city, which is within an hour's ride by rail from Mexico City, were built of adobe bricks, faced with stone and cement, and apparently were enlarged from time to time. On the top of each there was probably an altar dedicated to its particular god.



Photograph from Mrs. O. R. de Lozano

THE TEMPLE OF QUETZALCÓATL, OR THE "FEATHERED SNAKE"

Photograph by Clifton Adams

A DETAIL OF TOLTEC DECORATIVE SCULPTURE

One of the great stone snake heads that adorn the outer surface of one of the smaller and more ancient pyramids found inside the newly excavated citadel discovered near Teotihuacán.

Photograph from Mrs. O. R. de Lozano

THE LOFTY PYRAMID OF THE SUN AND THE PYRAMID OF THE MOON (MIDDLE BACKGROUND) AS SEEN FROM THE TEMPLE OF QUETZALCÓATL (IN THE FOREGROUND)

The Pyramid of the Sun and the ornate Temple of Quetzalcóatl speak forcefully of the wonderful organization of the Toltecs and the great skill their artisans acquired. It is believed that the rough and massive edifice at Cuicuilco inspired the descendants of its builders to create the mighty pyramids shown above (see text, page 215).

the crude rudiments of human culture, and when other members of the human family were struggling with like problems and fighting their way toward the light in other parts of the world.

The steps of human development from the simplest beginnings are as easily traceable in the Valley of Mexico as in Mesopotamia or the Valley of the Nile. Rudely chipped stone arrow and spear points and knives give way to finely chipped points and flaked blades of rare workmanship. Beautifully fashioned and polished stone hatchets and battle-axes are finally replaced by those of copper.

The progress of ornaments for the person can be traced from the crude clay and stone ear and lip pendants to elaborate jewels wrought in gold and engraved stones.

Domestic utensils manifest all stages of skill and adaptation, from the hammer stones and the grinding stones selected from the natural waterworn boulders of the river beds and lake shore, to the bowls, pitchers, and ollas beautifully fashioned of clay and burned, polished, and decorated with skill.

The development of the weaver's art is shown from rude baskets and coarse cloth to garments and mantles finely embroidered in a great variety of materials, designs, and colors.

A DISTINCT TYPE OF MAN DEVELOPED IN AMERICA

Sculpture is encountered everywhere, from the crudest of stone images to life-size and colossal representations of men, intricate geometrical designs, and elaborate symbols.

Thus, in every class of material known and used by prehistoric people, one can trace step by step the understanding and the mastery man gradually gained over his environment.

This knowledge of design and color combination, this mastery of form and proportion in a great variety of substances, and the ability to marshal men and materials in the construction of beautiful palaces and great temples, are results obtained by a people after generations and generations of practical experience.

In all is seen a distinct American type. The physiognomy of the skeletal remains, the architecture, the industrial and decorative arts, all show an American development.

Point out as we may similarities to Mongolian types, or to western Asiatic and Egyptian designs and conceptions, we must acknowledge after all that the early inhabitants of America were distinctly American. Their dissimilarities to Asiatics, both east and west, to Africans, and to Europeans are far more pronounced than their similarities. They form a large group of the human family, separated from the parent stock in some remote age, who, as they gradually multiplied and possessed themselves of this part of the globe, sought to surmount its obstacles and to become masters of their surroundings.

Is it strange that these people, engaged like those on the other side of this sphere in a struggle under similar climatic and geographic conditions, should develop some similar religious concepts, social customs, and artistic standards and designs?

The early American did not differ greatly from the early Asiatic, the early Egyptian, or even the primitive European. He offered such incense to his own gods as he thought best won their favor and coöperation, and tended his own garden and managed his own household in his own peculiar fashion; but he evolved many ideas, characteristics, and customs akin to those of his cousins across the seas. And is not this as we should expect?

Everything he touched, as shown in his architecture and his art, bears the stamp of his individuality and the influence of the natural phenomena of the Western World; and yet, at the same time, his works express the aspirations of the whole human race in its attempt to solve the mysteries of the universe and to understand its own relationship to its phenomena.

A FIELD FOR FURTHER RESEARCH

America thus has a prehistory extending far back into the early centuries of human development. The steps of her progress and the successes achieved are as interesting and instructive as any attained by the renowned human groups of the Old World.

Had the Spanish governors who were in control of Mexico in the first years

Photograph by Byron Cummings

THE EASTERN SIDE OF THE CUICUILCO MOUND, UNCOVERED TO THE LEVEL OF THE SURROUNDING LAVA, SHOWING TOPS OF WALLS OF TWO ENLARGEMENTS OF THE ORIGINAL STRUCTURE

The crude masonry of Cuicuilco is not so spectacular as the wonderful structures at Teotihuacán (pages 216-218), but it convinces us that native engineers built colossal monuments in very early times in Mexico. The fact that the pyramid at Cuicuilco had fallen into disuse, and that a considerable accumulation of earthy débris had gathered upon its slopes before the Pedregal lava flowed across the valley and partially covered this débris, adds greatly to our speculative and scientific interest in the ruin.

after the conquest been men of broader caliber and truer vision, the task of assembling the record of these glorious and heroic periods of human history in America would be comparatively simple.

The people themselves had done their duty and made permanent records of the ideals and achievements of the various nations. Some scholarly and honest priests and monks carefully studied and translated many of these records, but intolerance and ignorance consigned nearly all the manuscripts to the flames and sent their authors back to Europe.

However, the task, though thus made more difficult, is ours. The unraveling of the history of early America devolves upon American scholars from Canada to Chile, and it is hoped that the brains and energy necessary to carry the task to a successful conclusion will soon be forthcoming.

SOUP MAKES THE WHOLE MEAL TASTE BETTER

The most delicious tomato you ever tasted!

Think of the plumpest, ruddiest, juiciest tomato that ever tempted your taste. Remember how eagerly you ate it, how much you relished its delicious flavor. That's how much you'll enjoy Campbell's Tomato Soup! For it's the pure tomato goodness—the blend of the most tempting fruit that grows!

Our tomatoes grow to delicious ripeness right on the vines in the rich sun-bathed fields of New Jersey, far-famed as the world's garden-spot of tomato culture.

The tonic tomato juices and "meaty" parts of the fruit are strained to a smooth puree and blended with golden butter. The seasoning shows the delicate touch of the master-chef. Campbell's—the most delicious Tomato you ever tasted!

I've one little motto concerning tomato
It's the tastiest soup I know
And Campbell's perfection
Will be your selection.
If you envy my vigor and go!

21 kinds **12 cents a can**

Campbells' Soups

LOOK FOR THE RED AND WHITE LABEL

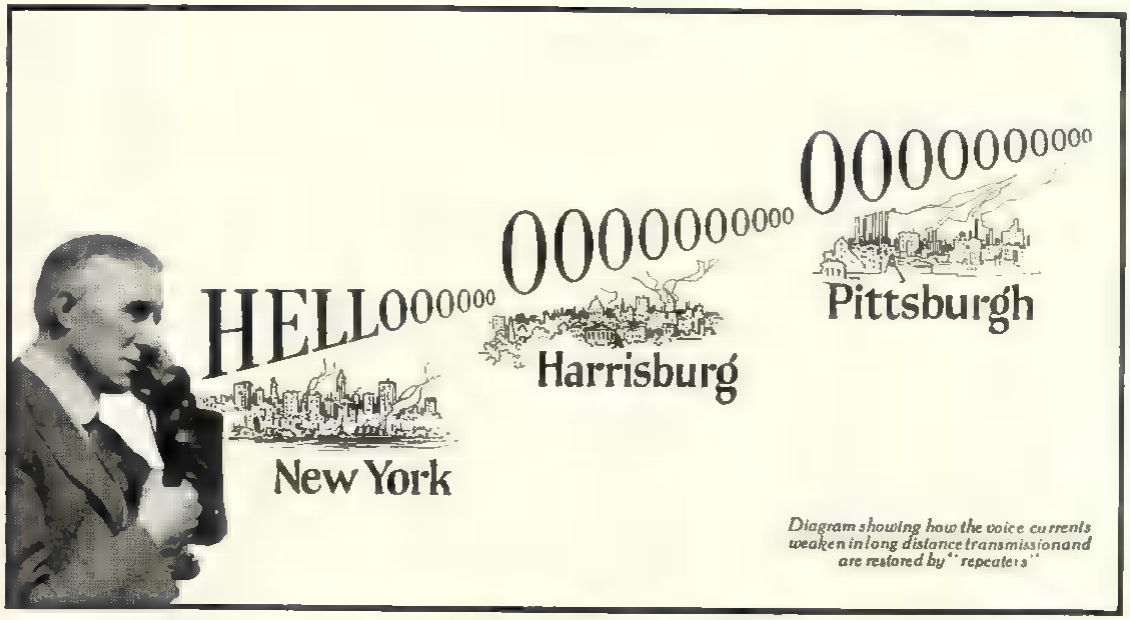


Diagram showing how the voice currents weaken in long distance transmission and are restored by "repeaters"

Mastering Nature's Forces

Without the telephone "repeater," the entire electrical power available on the earth would not be sufficient to make trans-continental speech commercially possible. The three thousand repeaters now in use on Bell System long distance lines have increased the talking range of every telephone by thousands of miles. By making possible the use of smaller gauge wires, repeaters have kept down the cost of equipment by millions of dollars.

The repeater is only one out of scores of scientific developments of equal or greater importance in the advancement of telephone service. Bell System progress has been a continual encounter with seemingly impossible barriers, and a continual finding of new ways to overcome them. Each step in extending the range of speech has come only after years of study. Each important piece of telephone apparatus has had to be created for the need. Each working day this pioneering goes on. Nature is harnessed to a new duty and mechanical ingenuity improves the tools of service, as fast as science finds the way.

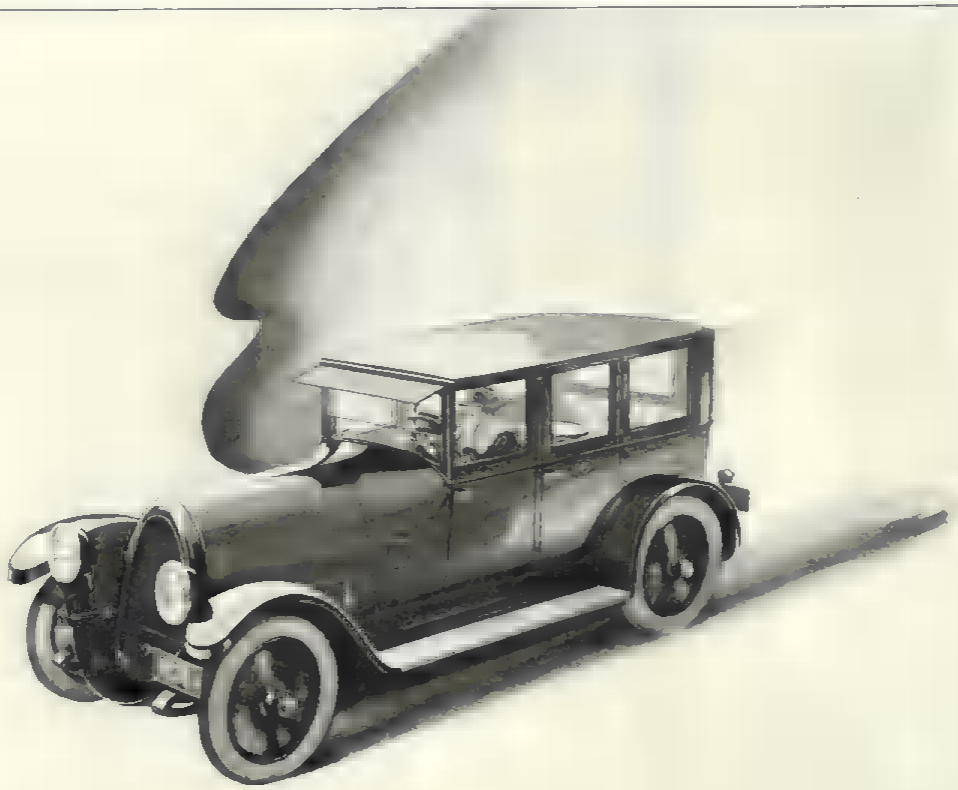
Not only is the Bell System daily conducting research within its own nation-wide organization, but it is studying the discoveries of the whole world of science for their possible application to telephone service. Only by such eternal vigilance has the United States been given the best and cheapest telephone service in the world.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service



Franklin

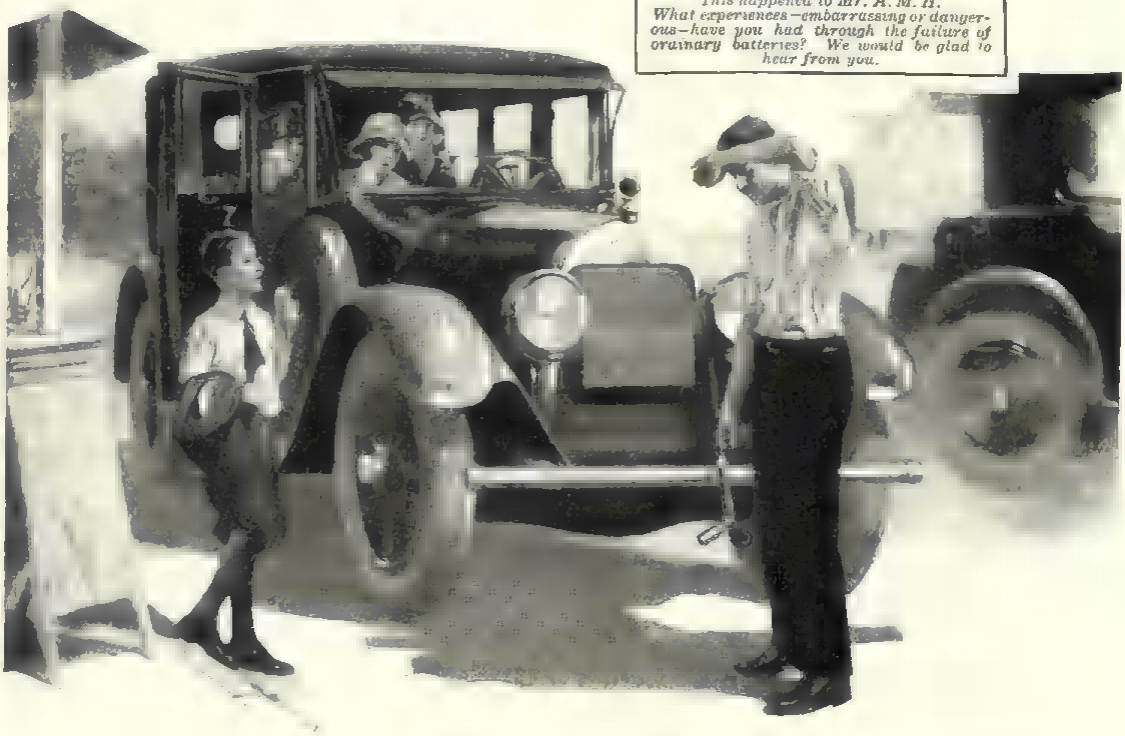
Keeping pace with the demand for this new Sedan has been a difficult task ever since it was first shown—even with production more than doubled.

The Franklin Sedan gives people the finest ride they ever had. That, in short, is the story of its unequalled road ability and accounts for its great popularity. It is without a closed car rival in comfort, easy handling and making time.

Powerful New Six Motor
Beautiful Body Design

THE FRANKLIN SEDAN $2850.

This happened to Mr. A. M. H. What experiences—embarrassing or dangerous—have you had through the failure of ordinary batteries? We would be glad to hear from you.



He tried to beat summer
with an ordinary battery

On a blazing hot day—on a week-end trip—his battery "burned out"—*its plates buckled, twisted, and short-circuited from overcharging.*

"Then I got my Philco," writes A. M. H., "for I don't want any more hand-cranking experiences—or costly breakdowns on the road—or trips spoiled for myself and my family."

You can't drive your car safely in summer—any more than in winter—with a weak, under-size battery. Hours of daylight driving means hours of heavy overcharging—*terrific punishment that your battery must stand.*

The Philco Diamond-Grid Battery has the OVERSIZE, shock-proof construction that absorbs the heat and stresses of summer driving. Also the tremendous excess power you need for trouble-free driving in winter.

Put a long-life, power-packed Philco in your car NOW. Summer is here and winter is coming. Then you'll demand a battery that whirls the stiffest engine—gives you quick-sure-fire ignition—keeps your lights brilliant hour after hour.

A Philco Diamond-Grid Battery with the famous Philco Retainers is now within the reach of every car owner. See your nearest Philco Station at once. Write for a complimentary copy of our new booklet, "How to Stretch Your Battery Dollar."

Philadelphia Storage Battery Co., Philadelphia

Philco Batteries are standard for Radio "A" and "B," electric motor trucks and passenger cars, mine locomotives and other battery users where long-lasting, low-cost service is demanded. Whatever you use Batteries for, write Philco.

NOW

a Genuine Philco Battery

$17.85

War Tax Paid

With the Famous Diamond-Grid Plates

Tremendous increase in Philco sales—efficient manufacture—economical distribution—have now placed a genuine Philco Diamond-Grid Battery within reach of every car owner.

$17.85 is the exchange price, east of the Mississippi River, for Ford, Chevrolet, Overland, Star, and other light cars. Philco Batteries for all other cars proportionately reduced.

There's a Philco Diamond-Grid Battery for every make and model of car—$17.85 to $125.

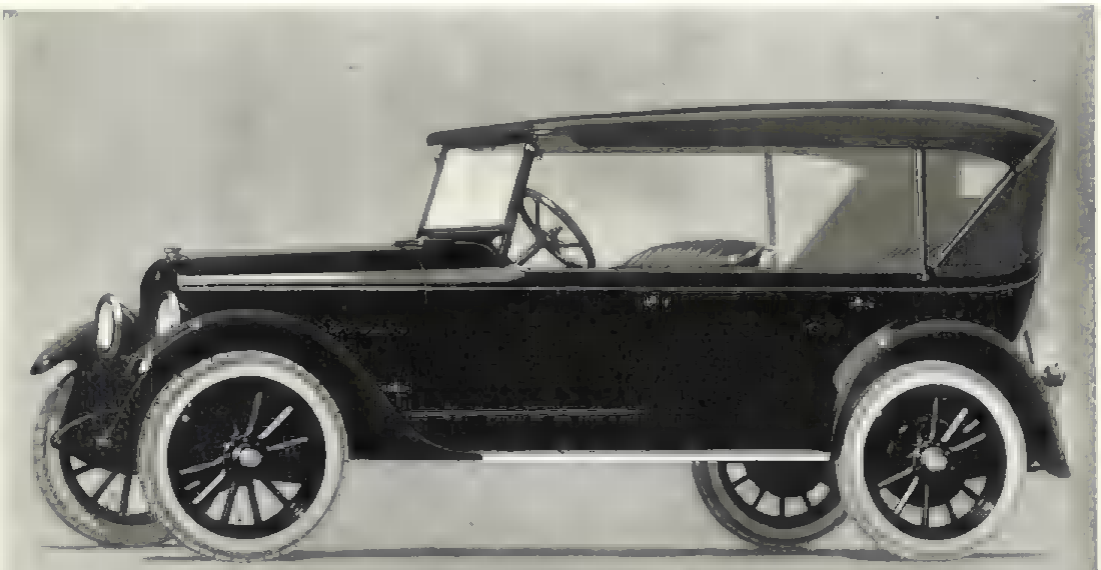
PHILCO

DIAMOND GRID BATTERIES

LOOK FOR THIS SIGN OF PHILCO SERVICE

PHILCO DIAMOND GRID BATTERIES

Over 5500 Philco Stations all over the U. S.



THE STUDEBAKER LIGHT-SIX TOURING CAR

MORE cars shake themselves to pieces than ever wear out. Charge that up to vibration, the most annoying bugaboo to engineers since the introduction of the automobile.

Vibration causes cars to grow old prematurely by racking their chassis, destroying the "metal life" of vital parts, loosening up their bodies and causing rattles. Frequent repairs are the result.

The Studebaker Light-Six is freer from vibration than any other car of its approximate size or weight yet produced.

This has been accomplished largely by a complete machining of the crankshaft and connecting rods on all surfaces—a practice used by Studebaker exclusively on cars at this price and found only on a few other cars whose prices are from three to ten times as high as that of the Light-Six.

The Light-Six motor embodies the most advanced design known to automobile construction. And no chassis at any price is built to more exacting standards of materials and workmanship.

Its substantial steel body, one-piece windshield, ten-inch cushions, and cowl lamps are among many features heretofore to be had only in higher-priced cars.

The name Studebaker is assurance of satisfaction.

MODELS AND PRICES—*f.o.b. U. S. factories*

LIGHT-SIX *5-Pass., 112" W.B., 40 H.P.*		SPECIAL-SIX *5-Pass., 119" W.B., 50 H.P.*		BIG-SIX *7-Pass., 126" W.B., 60 H.P.*	
Touring	$ 995	Touring	$1350	Touring	$1750
Roadster (3-Pass.)	975	Roadster (2-Pass.)	1325	Speedster (5-Pass.)	1835
Coupe-Road. (2-Pass.)	1225	Coupe (5-Pass.)	1975	Coupe (5-Pass.)	2550
Sedan	1550	Sedan	2050	Sedan	2750

Prices Subject to Change Without Notice

STUDEBAKER

Detroit, Michigan — South Bend, Indiana — Walkerville, Canada

Address all Correspondence to South Bend

THIS IS A STUDEBAKER YEAR

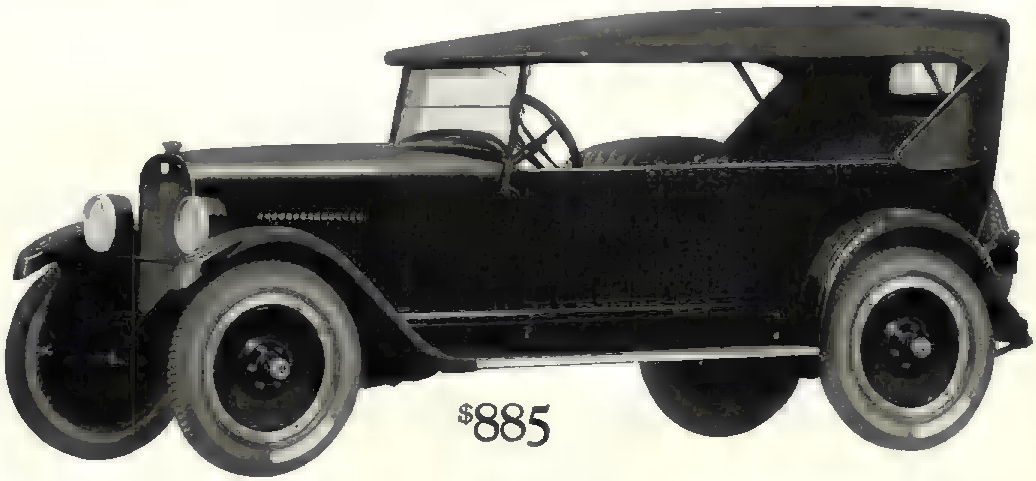
"Cheer up, Tom. If you don't enjoy these little roadside tête-à-têtes, you ought to use Kelly tires."

FOR many years Kelly-Springfield tires have been famous for the mileage they gave and the trouble they did not give.

The Kelly Kant-Slip Cord, the newest member of the Kelly family, has maintained this reputation for sturdiness and in addition has earned one of its own for surefootedness.

The owner of Kelly cords rides, not only in comfort, but also in safety, on practically all kinds of roads and in all kinds of weather.

It costs *no more* to buy a Kelly.



The Good

MAXWELL

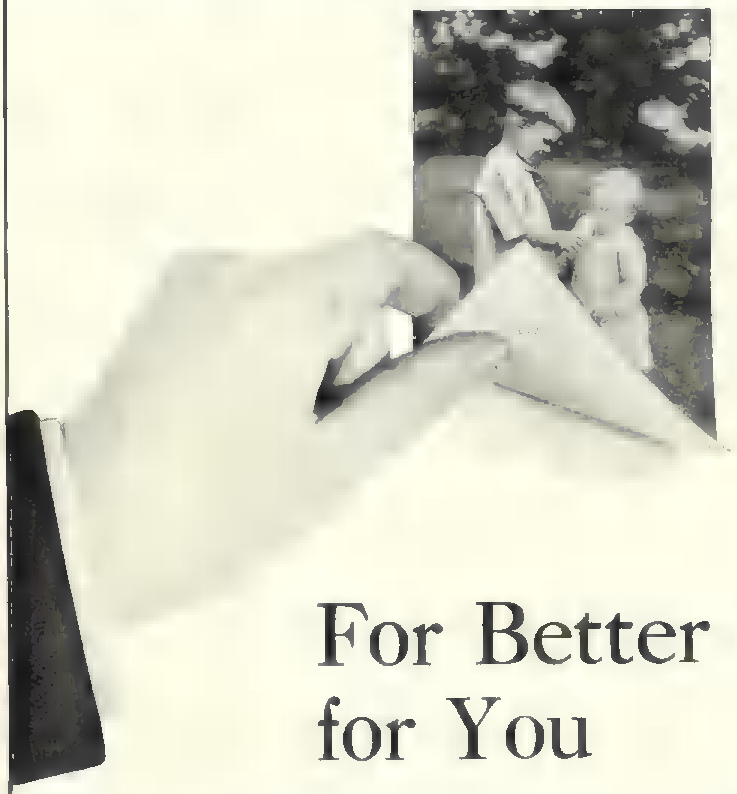
The success of the good Maxwell is working a momentous change in motor-car buying.

For months the buying public has been making its comparisons on the basis of the good Maxwell—for the simple reason that the good Maxwell gives more for the money than the public has been used to getting.

The good Maxwell deserves to dominate its own market, on the strength of its wonderfully fine owner-records, and every passing day brings that domination closer to complete accomplishment.

Cord tires, non-skid front and rear; disc steel wheels; demountable at rim and at hub; drum type lamps; pressure chassis lubrication; motor driven electric horn; unusually long springs; new type water-tight windshield. Prices F. O. B. Detroit, revenue tax to be added: Touring Car, $885; Roadster, $885; Sport Touring, $1025; Sport Roadster, $975; Club Coupe, $985; Four-Passenger Coupe, $1235; Sedan, $1335

MAXWELL MOTOR CORPORATION, DETROIT, MICH.
Maxwell-Chalmers Motor Co. of Canada, Limited, Windsor, Ontario



"A trademark is a mark by which the wares of the owner are known in trade. Its object is two-fold: . . . . . to protect the public from imposition . . . . . The trademark brands the goods as genuine, just as the signature ■ ■ letter stamps it as authentic." Coxe, J., in Shaw Stocking Co. v. Mack, 12, Fed. Rep. 707, 710.

For Better Prints for You

To protect our Kodak customers and to protect those Developing and Printing establishments which, by using the best materials, endeavor to give their customers the best possible results, we have made Velox paper identifiable. The trade name "Velox" is printed, faintly, on the back of every sheet—readable but not obtrusive.

Negatives made by the professional photographer under the soft and well-modulated light of the studio demand one kind of paper and those made by the amateur under harsh light conditions require another kind. No one paper can properly serve both purposes.

Velox is the only photographic paper made exclusively for printing from amateur negatives. It exactly meets the requirements of amateurs and amateur negatives.

If your finisher uses the best possible paper—even though it costs him a little more—it is an indication that he is using the best possible equipment and chemicals, and employing capable workmen. In short, your films have been left in careful hands.

Look for "Velox" on the Back

Eastman Kodak Company, Rochester, N.Y. *The Kodak City*

NOTE: The Trade-mark on every sheet does not apply in Canada as yet.

Simmons beds, the Charlton design, shown here in brown mahogany finish

Also in soft green, ivory, old blue and walnut. Prices surprisingly moderate

Henry Ford believes that even a machine needs rest

When asked why he favored short hours for workers, Henry Ford said that no good engineer will run even a machine at the limit of its power and speed for very long.

It hurts the machine. It isn't sentimentalism to take care of machines—or men. It is plain common sense and efficiency.

Sleep recharges the batteries of energy. It repairs and keeps in working order the fine mechanism of the human body. When you are tired or run down, sound sleep winds you up for the succeeding day.

It is good judgment and economy, therefore, to own and use the kind of bedding that will give you deep and restful sleep.

Spare ten minutes tonight to get acquainted with the bed you sleep on. Then go to your furniture dealer's and compare what you are using with the Simmons springs and mattresses he offers in a wide range of styles and prices.

Weigh the facts and decide whether you are getting the energy-restoring rest your living machine needs—and can enjoy now at such moderate cost.

Write for your copy of "Restful Bedrooms," The Simmons Co., 1347 Michigan Ave., Chicago In Canada, please address Simmons, Limited, 400 St. Ambroise Street, Montreal, Quebec

SIMMONS

Beds · Mattresses · Springs

BUILT FOR SLEEP

If You Could SEE the Atmosphere in Your Home

WHY do you take a deep breath when you step outdoors? That's right! Your system craves the pure fresh air. But WHY is the outdoor atmosphere so different from that in your home? The difference would surprise you if you could only SEE the atmosphere.

The vitalizing element of the atmosphere in most homes is largely destroyed by overheating or stagnation. Fire poison and personal contamination—enemies more prevalent than are realized—render the air still more unfit for breathing, sap your vitality, and increase your susceptibility to disease.

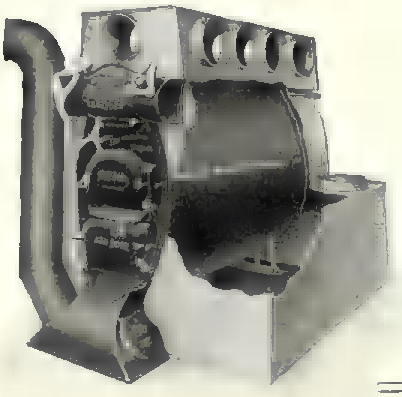
The mission of the FarQuar System is to provide stimulating warmth and maintain an atmosphere that is pure, fresh, and invigorating—a result realized through scientific construction based on established principles of hygienic heating.

Therein lies the difference between ordinary heating systems and the FarQuar—a difference that means renewed vigor and better health.

Some Exclusive FarQuar Features

THE FARQUAR SANITARY HEATING AND VENTILATING SYSTEM

An electrically welded, seamless steel fire-box prevents escape of fire poisons; a positive automatic control insures uniform temperatures with once-a-day firing; large air capacities insure mildly warm temperature; adequate ventilating system evenly distributes heat, prevents stagnation of air, and promptly removes all personal contamination.



Now you see WHY the FarQuar System accomplishes results impossible with any other heating method.

If interested in a better atmosphere in the home, ask for FarQuar booklet, free to home owners and builders.

The Farquhar Furnace Co.

908 FarQuar Bldg. Wilmington, Ohio

Enthusiastic users often become interested in the sale of the FarQuar Heating and Ventilating System. Some choice territory still open. Write for particulars.

Just as rain —

freshens the foliage of Nature's children in field and forest, so a shower refreshes you

IN NATURE'S way of washing, the water is used *once*. It passes on, carrying away everything of which it has cleansed the pores of flower and plant.

H-952½ Mixometer Shower. For use in stall or over built-in tub. A turn of the Mixometer handle controls the shower's temperature. By the Anyforce Head, you control the shower's force. This head is placed at an angle, not necessary to wet the hair.

And so it is with your shower. The clear, sparkling sprays strike your back, chest, arms—your entire body. Each flushed-out pore again breathes naturally as the water runs off. You are stimulated and refreshed.

Not only have those scintillating sprays cleansed, but they have massaged as well

In all the better class homes being built today, showers are part of the regular bathroom equipment. And where alterations to bathrooms are being made or considered, showers are always included.

There are many types of showers. To aid you in selecting the right type for your home, we have a booklet entitled "Once-Used Water." If you are really interested, we'll be glad to send you a copy. In writing for "Once-Used Water," if you have a regular plumber, will you please mention his name?

SPEAKMAN COMPANY, WILMINGTON, DELAWARE

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SANITAS
MODERN
WALL COVERING

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THE STANDARD
STP
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Your walls express your real self

An appropriate use of Sanitas Modern Wall Covering is a beautiful expression of the good taste of the inmates of a home. And it is so easy to use good taste with Sanitas—every pattern and coloring seems to have a distinctive place all its own.

Sanitas comes in styles for every room in the house. It is made on cloth, sturdy and durable, and machine-painted with oil colors. It does not fade, crack, tear, or peel. Wiping with a damp cloth keeps it clean and fresh. Sanitas is not an expense, but an investment.

Enamel Finish	*Flat Finish*	*Decorative Patterns*
in plain colors, striped, mottled, tile and mosaic effects, for kitchens, bathrooms, laundries, etc.	plain colors, for flat tones that can be paneled, stenciled, frescoed, stippled or Tiffany blended.	floral designs, reproductions of tapestry, grass-cloth, chambray, burlap, leather, rough-tile.

Your decorator will gladly show you Sanitas.

Write us for samples and booklet.

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A Certificate, protecting you against inferior granites, will accompany each memorial of ***Rock of Ages,*** if your request is made when placing order.

Illustrated Booklet "E" Upon Request

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Quarriers of
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America's
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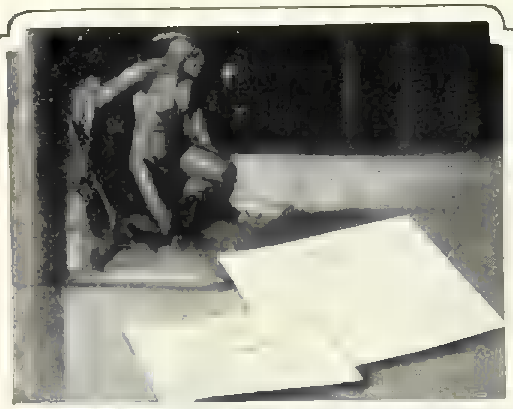

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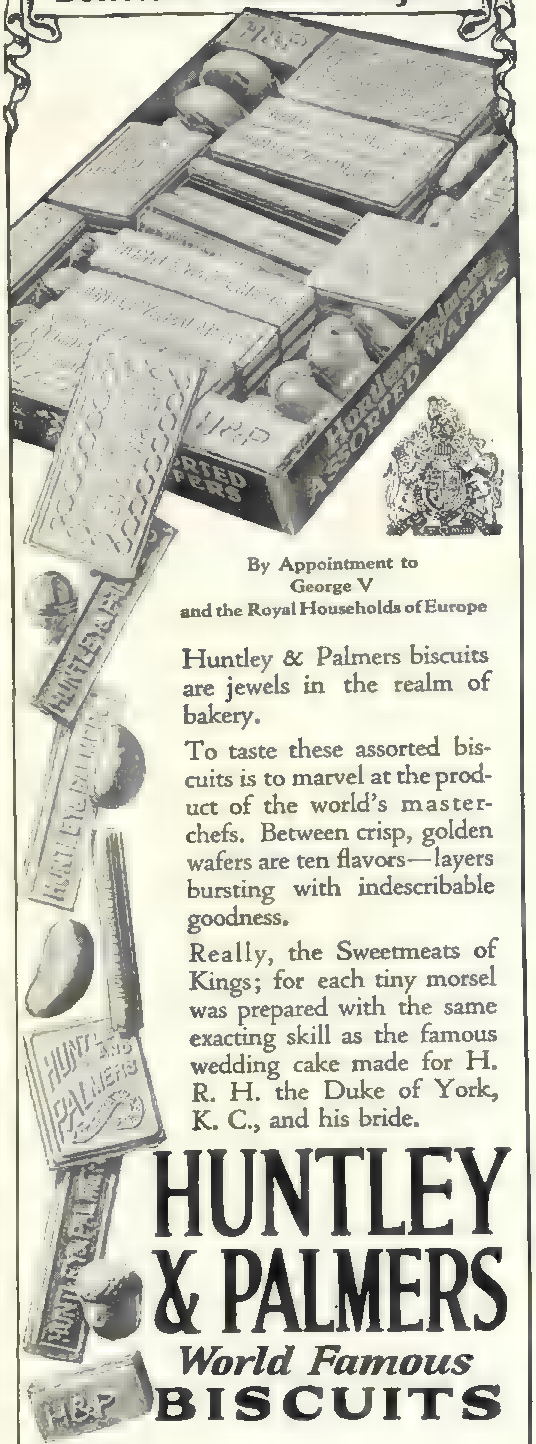
Delicious Assorted Wafers



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and the Royal Households of Europe

Huntley & Palmers biscuits are jewels in the realm of bakery.

To taste these assorted biscuits is to marvel at the product of the world's master-chefs. Between crisp, golden wafers are ten flavors—layers bursting with indescribable goodness.

Really, the Sweetmeats of Kings; for each tiny morsel was prepared with the same exacting skill as the famous wedding cake made for H. R. H. the Duke of York, K. C., and his bride.

HUNTLEY & PALMERS
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If high-grade grocers cannot supply you, send for
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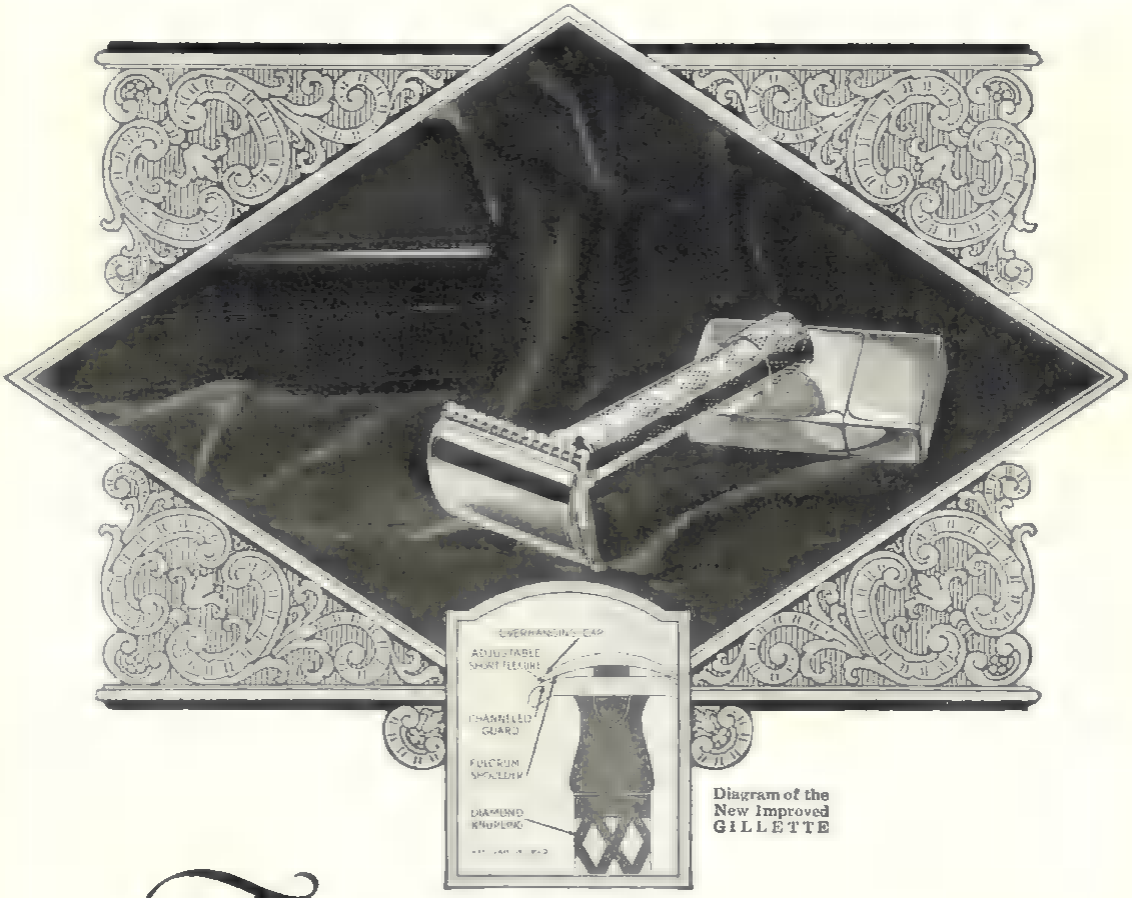

Diagram of the New Improved GILLETTE

THE New Improved Gillette has that unmistakable atmosphere of quality which marks the thoroughbred. And, in performing its daily function of shaving perfectly, it fulfills the promise made on first acquaintance. The price is $5 and up.

"Three Reasons" is a booklet sent upon request which makes clear the reasons for smooth, comfortable shaving.

The New Improved

Gillette

SAFETY Gillette RAZOR

GILLETTE SAFETY RAZOR CO., BOSTON, U.S.A.

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IF you are a prospective traveler, why not plan a trip to South America? Four white sister ships owned by the U. S. Government and operated by the Munson Line have brought new business opportunities and a new vacation land. Send the information blank below and let your Government assist you with travel helps.

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You'll want to take something good to eat; that's Kraft Cheese.

Rain or shine your Kraft Cheese—in tins—will be safe. Make your cheese sandwiches fresh when you're ready to eat.

For any outing there's nothing to equal it; solid nourishment, compact, convenient. It's good until you open it; very good when you eat it; a meal by itself.

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No rind—it spreads. No waste—100% cheese.

Cheese Recipe Book **FREE**

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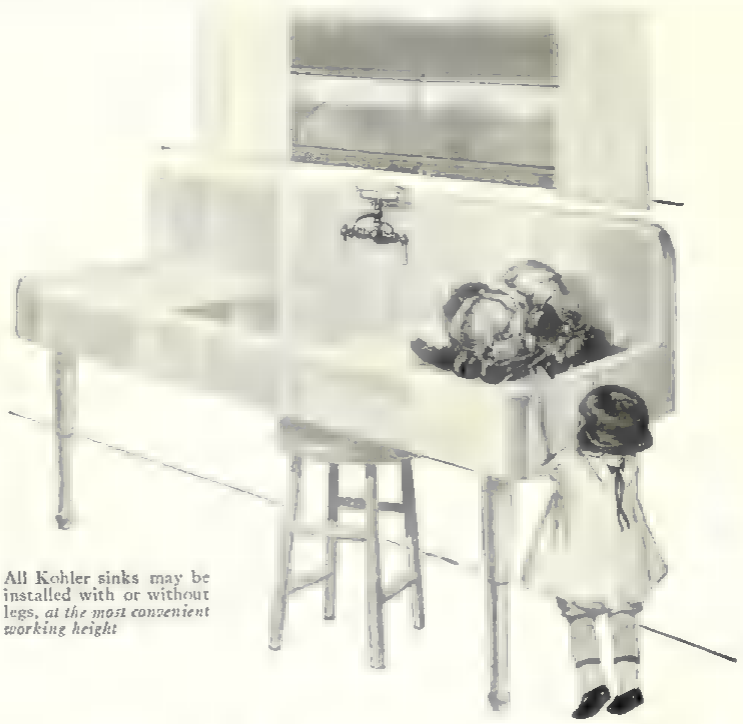

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What a spotless laboratory and livable room, all in one, the modern kitchen has become!

Today, your kitchen is *you*. Your friends expect it to measure up. And, if it does, how proudly you throw open its door and present it for inspection!

Yours is the satisfaction of owning the best if your sink is of Kohler Ware. You can buy nothing finer. Every Kohler sink possesses the same surpassing quality of enamel and the same distinction of design that have won Kohler Ware for bathrooms its assured position in the best-appointed homes of America.

Good plumbing dealers everywhere sell the products of the half-century-old house of Kohler of Kohler. Our booklet (please write for it) will show you Kohler fixtures for bathrooms, kitchens, and laundries.

KOHLER

Look for this name, unobtrusively fused into the enamel of every Kohler fixture. It is your guaranty of genuineness and of these distinctive Kohler qualities—(1) the beautiful snowy whiteness of the durable enamel, (2) the *uniformity* of that whiteness in every fixture.

KOHLER OF KOHLER

Kohler Co., *Founded 1873*, Kohler, Wisconsin *Shipping Point*, Sheboygan, Wisconsin

BRANCHES IN PRINCIPAL CITIES

MANUFACTURERS OF ENAMELED PLUMBING WARE AND KOHLER AUTOMATIC POWER AND LIGHT 110 VOLT D. C.

W. L. DOUGLAS

SHOES ARE MADE BY SKILLED SHOEMAKERS

We have in our 116 stores a wonderful assortment of kinds and styles of high-class, stylish shoes, suitable for Men, Women and Boys in all walks of life. They are made of high-grade, selected leathers. Fine Calf and Vici Kid shoes are our specialty. The quality, style and workmanship are unsurpassed.

YOU CAN ALWAYS SAVE MONEY BY WEARING W. L. DOUGLAS SHOES SOLD DIRECT FROM FACTORY TO YOU AT ONE PROFIT

If you have been paying high prices for shoes, why not try a pair of W. L. Douglas $8.00 shoes? They are exceptionally good value. Frankly, is it not worth while for you to dress your feet in shoes that hold their shape, are easy-fitting, look well, wear well and are reasonable in price?

$5. $6. $7. $8. & $9. SHOES

$4.50 & $5.00 SHOES FOR BOYS

For thirty-seven years W. L. Douglas name and portrait have stood for a high standard of quality and dependable value. For economy and satisfactory service wear shoes that bear this trade mark. Ask your dealer for W. L. Douglas shoes. Look for W. L. Douglas name and the retail price stamped on the sole. Refuse substitutes.

IF NOT FOR SALE IN YOUR VICINITY, WRITE FOR ILLUSTRATED CATALOG SHOWING HOW TO ORDER SHOES BY MAIL. POSTAGE FREE.

W. L. Douglas

President
W. L. Douglas Shoe Co.
130 Spark Street, Brockton, Mass.

***TO MERCHANTS:** If no dealer in your town handles W. L. Douglas shoes, write today for exclusive rights to handle this quick-selling, quick turn-over line.*

ESTABLISHED 1876

DUES

Annual membership in U. S., $3.00; annual membership abroad, $4.00; Canada, $3.50; life membership, $100. Please make remittances payable to the National Geographic Society, and if at a distance remit by New York draft, postal or express order.

RECOMMENDATION FOR MEMBERSHIP

IN THE

NATIONAL GEOGRAPHIC SOCIETY

The Membership Fee Includes Subscription to the National Geographic Magazine

PLEASE DETACH AND FILL IN BLANK BELOW AND SEND TO THE SECRETARY

----------192

To the Secretary, National Geographic Society,
Sixteenth and M Streets Northwest, Washington, D. C.:

I nominate----------

Occupation----------
(This information is important for the records.)

Address----------

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for membership in the Society.

Name and Address of Nominating Member

8-23

Good Buildings Deserve Good Hardware

Good Hardware—Good Service

—you get both when you go to the Corbin Dealer

THE Corbin dealer in your city is a specialist in Builders' Hardware. He knows how to read architects' blue-prints and specifications. He knows how to select the right hardware for each individual window and door in your home.

Every Corbin dealer has back of him a complete line of builders' hardware made by a firm that has been a leader in its field for seventy-four years.

You will probably buy hardware but once—all the more reason for buying good hardware when you do build.

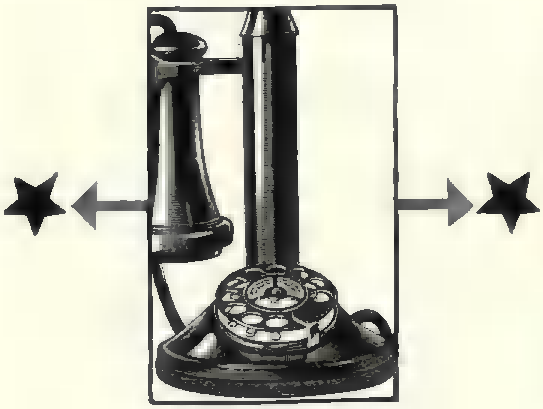
Visit the Builders' Hardware Department of your local Corbin dealer. The truth that "good buildings deserve good hardware", will there be revealed to you in its full meaning. If you don't know who the Corbin dealer is, write to us.

P. & F. CORBIN SINCE 1849 NEW BRITAIN CONNECTICUT

The American Hardware Corporation, Successor

NEW YORK CHICAGO PHILADELPHIA

Send for booklet, "Good Buildings Deserve Good Hardware"—finely illustrated and chock full of information.



The P-A-X is similar to the Automatic Telephone equipment being so widely adopted for city service. It augments and completes but does not supplant nor connect with local or long distance telephone service

At This Moment Other Executives, too, Are Reading This Ad!

And they have the same thought—"What will the P-A-X do for my organization?"

Your problems of overhead, production and service cannot be radically different from those of the thousand concerns who are actually profiting by the P-A-X today.

This remarkable equipment is not an *added* expense—but the final solution of many problems that confront you right now.

We will tell you frankly and accurately how the P-A-X will *pay* you.

We feel we are rendering a worthwhile service in sending you our book—"The Straight Line."

Perhaps the coupon will save time. Send it or letter for this book.

P-A-X

TRADE MARK

THE PRIVATE AUTOMATIC EXCHANGE

What the P-A-X will do for You

1. Handle all your intercommunicating calls at no expense for operators' salaries.
2. Materially reduce your rental expense of telephone instruments.
3. Save you eighteen seconds on every call.
4. Keep you in constant touch with every department of your business.
5. Give you twenty-four-hour service, and no operator required.
6. Insure absolute secrecy to your conversations.
7. Give you the advantages of the "Conference Line," "Code Call" and other Automatic Services.

Automatic Electric Company

ENGINEERS, DESIGNERS & MANUFACTURERS OF THE AUTOMATIC TELEPHONE IN USE THE WORLD OVER

HOME OFFICE AND FACTORY: CHICAGO, U. S. A.

Branch Offices in All Principal Cities

Automatic Electric Co., 947 W. Van Buren St., Chicago, Ill.

Gentlemen: Please send me "The Straight Line." N-2

Name .....

Title .....

Name of my Company .....

Address .....

Write for folder showing full line of Kampkooking necessities.

When the Appetite Talks

After a strenuous day in the fresh outdoor air, touring, fishing, swimming—and your appetite is talking—that is when you appreciate your

AMERICAN KAMPKOOK
THE IDEAL CAMP STOVE

It's All Inside
All Kampkooks fold as shown when not in use with all parts packed inside, protected against loss or breakage.

Always ready for any cooking job, set up and going in one minute. Makes its own gas from motor gasoline. Burns a hot blue flame; no smoke, soot or odor. Wind proof, safe anywhere. Used by most experienced campers. Six styles $7.50 to $15.60. At leading dealers everywhere.

American Gas Machine Co., Inc.
834 Clark St., Albert Lea, Minn.

Cleans a Toilet as Nothing Else Will

Thoroughly, swiftly, easily—Sani-Flush cleans toilet bowls. All stains, discolorations, incrustations disappear. The bowl shines.

No scrubbing. No scouring. Just sprinkle Sani-Flush into the bowl. Follow directions on the can. Flush!

The hidden trap is unhealthful if unclean. Sani-Flush reaches it—cleans it—purifies it. Nothing else will do this! Sani-Flush destroys all foul odors. It will not harm plumbing connections.

Always keep Sani-Flush handy in the bathroom.

Sani-Flush is sold at grocery, drug, hardware, plumbing and house-furnishing stores. Price 25c. (Canadian price, 35c; foreign price, 50c.)

THE HYGIENIC PRODUCTS CO., Canton, Ohio

Foreign Agents: Harold F. Ritchie & Co., Ltd., Toronto, Canada
33 Farringdon Road, London, E. C. 1, England
China House, Sydney, Australia

Sani-Flush

Cleans Closet Bowls Without Scouring

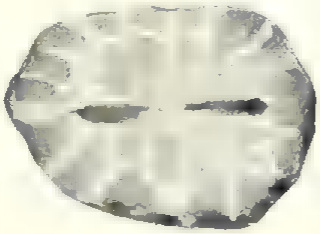
Keep that hand soft!

You will find this monogram on many devices that help to make housework easy. On Edison and National MAZDA Lamps, motors that run domestic machines, and electrical devices of many kinds. The letters G-E are more than a trade-mark. They are a symbol of service—the initials of a friend.

"We can't afford servants," said most young married couples fifty years ago. "They cost too much in wages and food."

But there is no bride today who cannot afford the *modern* servants—the electric devices that ask for no afternoon off, eat nothing, and work untiringly for an average wage of only three cents an hour.

GENERAL ELECTRIC



Magnified Pettijohn flake

See the Bran
In these delicious flakes

Pettijohn's makes bran inviting by hiding it in luscious flakes of wheat. It is rolled soft wheat—the most flavory wheat that grows. Breakfast never brings a more delightful dish. Yet those rich flakes hide 25% of bran.

So it supplies whole wheat with its 12 essential minerals and its vitamines. And it supplies the daily need of bran.

You will never find a better way to make bran popular. You'll be glad to know it. Try it tomorrow.

Pettijohn's

Rolled Soft Wheat—25% Bran

WHERE
the Summer's heat is exhausting try this:

Into a glass of cool water, stir a teaspoonful of Horsford's Acid Phosphate, and drink. Its "tart" delights the palate and quenches thirst, its PHOSPHATES, like those found in cereals, quiet the nerves and refresh the system.

HORSFORD'S ACID PHOSPHATE

refreshes the body and tissues with this desirable element in a readily assimilable and throat delighting form. At Druggists.

Write for SPECIAL BOOKLET telling how to make delicious fruit drinks, ices, etc., and giving important information about the nutritious PHOSPHATES. Sent free. Address

RUMFORD CHEMICAL WORKS
PROVIDENCE, R. I. M-49

Baltimore Oriole
in natural colors
Pictures—7x9 inches

Dodson Bird and Nature Pictures

Just send $1.00

A lovely set of color pictures—30 for $1.00—will be sent you from Mr. Dodson's famous MUMFORD collection of authentic pictures. Learn the birds, flowers, fruits, and other beauties! Splendid for children. For camp, home or school. A special set for $1.00, with list of six hundred and more other fascinating studies.

JOSEPH H. DODSON, Inc.
702 Harrison Ave. Kankakee, Ill.

MR. DODSON IS FAMOUS AS THE ORIGINAL BIRD HOUSE MAN

RAISE HEALTHY DOGS
BY FEEDING THEM ON

SPRATT'S FOODS

For more than 50 years SPRATT'S Foods have been used by dog owners, breeders and exhibitors throughout the world

SPRATT'S manufacture a food for cats, poultry, game, etc. Made only of the most nourishing and health-giving ingredients, SPRATT'S Foods when used as a steady diet will keep your pets and poultry in perfect health.

Try SPRATT'S OVALS, the new pocket dog biscuit for every size and breed. Ask for SPRATT'S and be sure that you get SPRATT'S only.

Write for sample and name of nearest agent. Enclose 2c for pamphlet G8 on feeding.

SPRATT'S PATENT LIMITED
Newark, N. J.

THIS MAGAZINE IS FROM OUR PRESSES

JUDD & DETWEILER, INC.
Master Printers

ECKINGTON PLACE AND FLORIDA AVENUE WASHINGTON, D. C.

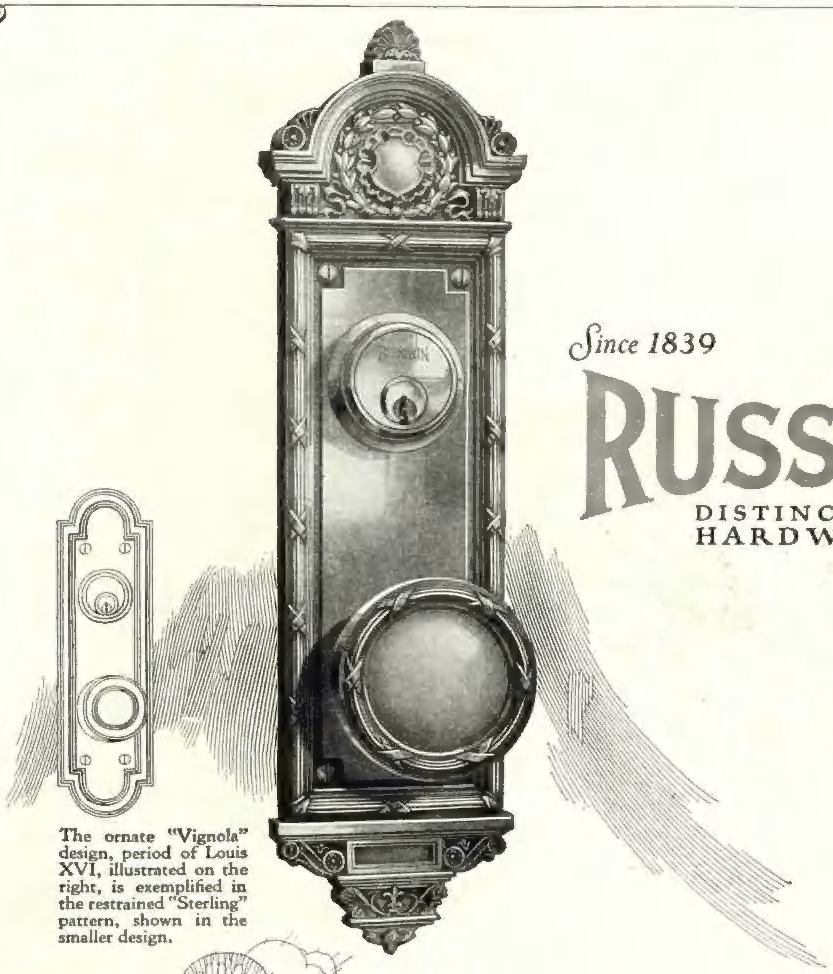
The Prophylactic Tooth Brush

Ask your druggist for "the brush in the yellow box"—he knows

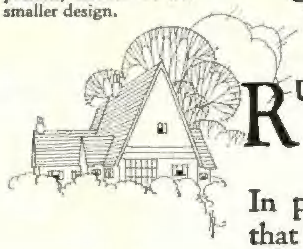
Since 1839

RUSSWIN

DISTINCTIVE HARDWARE



The ornate "Vignola" design, period of Louis XVI, illustrated on the right, is exemplified in the restrained "Sterling" pattern, shown in the smaller design.



RUSSWIN means Art and Quality—like the hallmark on Silver. It is your guarantee of satisfaction in Builders Hardware.

In palatial mansion or suburban home, good taste dictates that the appointments of doors and windows should harmonize with the character of the architecture.

—and in every piece of Russwin Hardware you see the work of artist-designers and master-craftsmen. In every delicate tracing, in each element of line and form, there is beauty of classic proportion and good taste in design.

And the lasting beauty and good taste of Russwin Hardware are but the outward expression of mechanical perfection, enduring finish, and trouble-free service.

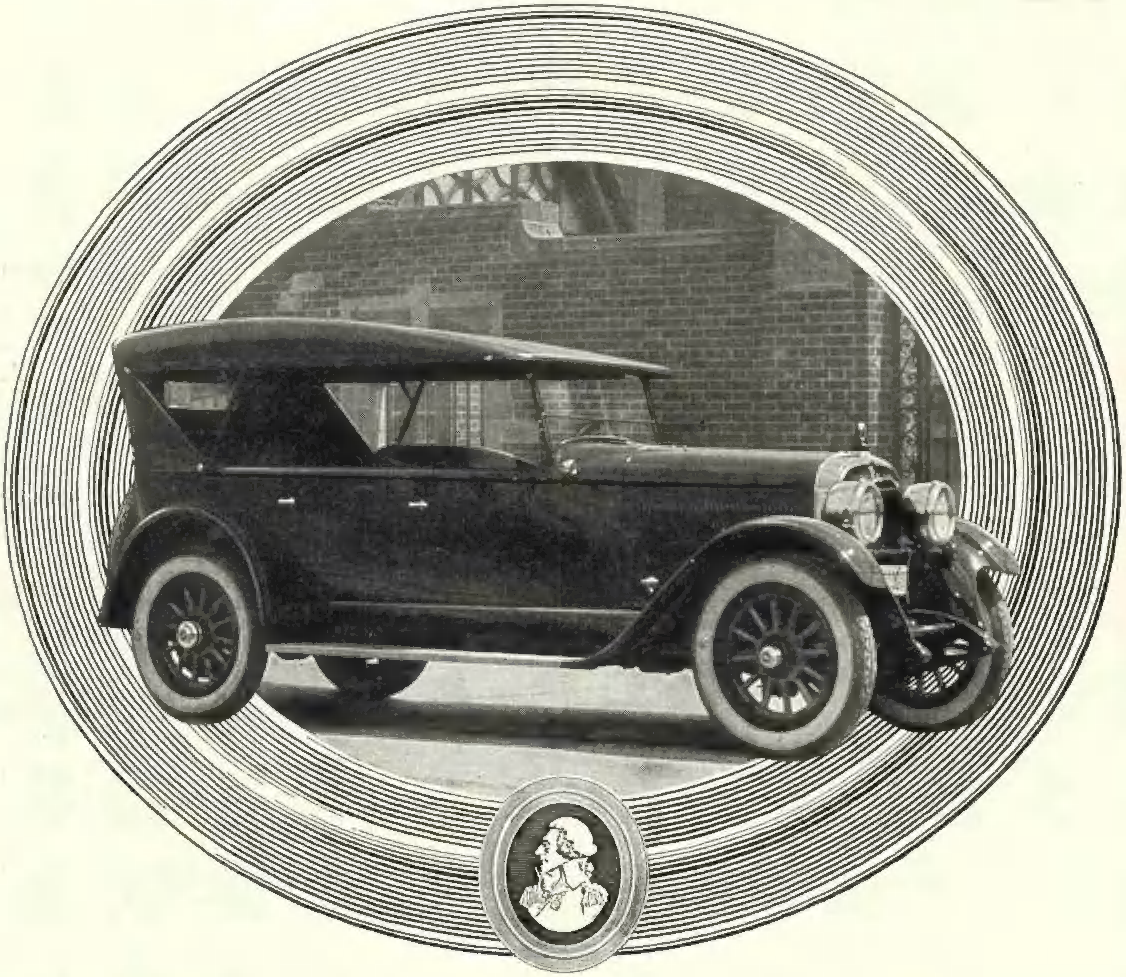
"To Russwin-ize is to Economize"

Russell & Erwin Manufacturing Co.

The American Hardware Corpn., Suc.

New Britain, Connecticut

New York San Francisco London Chicago



Most men gain from their motoring experience a very definite idea of the car they some day hope to own.

It is a car that has the virtues of the many and the flaws of none, a car that is built to last and serve economically far beyond the accepted span.

In design, it is established and perfected; in beauty, staunch and perennially good; in power, supple, quiet and supreme.

Its comfort transcends other fine cars they have owned; its maintenance cost is pleasurably low.

To LaFayette owners, this car is no longer an imaginary thing. It is a reality that is theirs to enjoy today and every day for many years to come.

Steadily the conviction that the LaFayette is one of the world's finest motor cars is finding wider and wider acceptance as the experience of LaFayette owners becomes known

LaFayette Motors Corporation
Milwaukee, Wisconsin

LAFAYETTE

From Southern Pines

Nature sends this safe aid for your hair's loveliness

In the Southern States grows the long needle pine tree whose refreshing fragrance bespeaks its beneficial properties.

To aid hair health and so to increase hair loveliness, this Southern Pine yields its generous gift of pine-tar. This and other bland ingredients are combined in Packer's Tar Soap or Packer's Liquid Shampoo.

When you adopt the Packer method of shampooing you are using Nature's own gifts to assist her in expressing all the latent loveliness of your hair; to reveal all its charming little glints and gleams.

If Nature is given this safe aid you may expect her to reward you in these two ways.

Improved Appearance and Bettered Hair Health

Your first Packer shampoo! Notice how your hair, thoroughly yet gently cleansed, fluffs up charmingly—suggestive of luxurious abundance.

Continue your Packer shampoos at regular intervals. They assist Nature to bring about the two conditions so essential to lovely, lustrous hair—a normal flow of natural oil and proper nourishment.

The Packer method of shampooing encourages this normal oil flow which guards, at once, against dry and brittle or too oily hair. Further, Packer's Pine-tar and the other bland ingredients reach into the scalp pores. Thus healthfully cleansed and invigorated your scalp sends to the hair a continuous flow of nourishment.

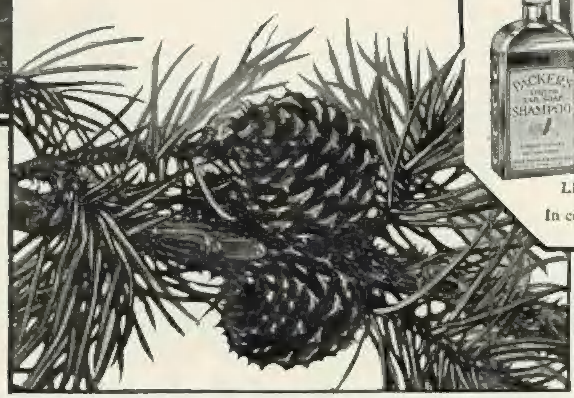
Pine-tar Endorsed by Physicians

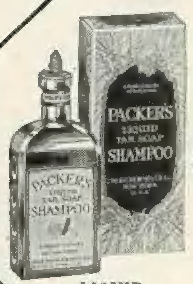
As a natural aid to hair health, pine-tar as incorporated in Packer's Tar Soap is widely endorsed by physicians. And we recommend Packer shampoos especially to maintain the golden gleam of blond hair. Notice how the creamy Packer lather helps to reveal the charm and allure of your hair no matter what its shade.

THE PACKER MANUFACTURING CO., INC.
120 WEST 32nd STREET, NEW YORK CITY

Canadian Wholesale Distributors
Lymans, Limited, Montreal.
The Lyman Bros. & Co., Ltd., Toronto

Shampoo with
PACKER'S





LIQUID
In convenient liquid form

Now!
Every cake in a metal soap box

CAKE
In the new metal soap box

Special Sample Offer:

Generous samples of Packer's Tar Soap, Packer's Liquid Shampoo, and Packer's Charm, a soothing skin lotion, will be mailed on receipt of 25c—or send 10c for any one sample. We will gladly send, free, our Manual, "How to care for the Hair and Scalp." Address: Packer Manufacturing Co., Inc., Dept. 90-H, 120 West 32d St., New York, N.Y.

PRESS OF JUDD & DETWEILER, INC.
WASHINGTON, D. C.

To the Father of the American Boy

The kind of man your boy will be is being determined now, during those boyhood years when Dad is a fellow's hero. When Dad takes time to talk about good health—well, that means something.

Teach your boy now to take proper care of his teeth. Then give him a dentifrice that is safe to use for a lifetime.

Free from grit and harmful drugs, Colgate's Ribbon Dental Cream is an ideal dentifrice. Its specially prepared, non-gritty chalk loosens clinging particles from the enamel. Pure and mild, its vegetable-oil soap washes them away. Large tube, 25c.

BOYS: If your Dad hasn't seen this page, show it to him and write us what he says. We will then send you a generous sample tube of Colgate's Ribbon Dental Cream—just the right size to carry in your hike kit.

COLGATE & CO.,
Dept. 66,
199 Fulton St., New York City

CLEANS TEETH THE RIGHT WAY
Washes and Polishes
Doesn't Scratch or Scour

If your wisdom teeth could talk they'd say, "Use Colgate's"

Truth in Advertising Implies Honesty in Manufacture